

MAY 1963 35 CENTS

Popular Science

Monthly

We Test Those

HOT COMPACTS

PAGE 53



Lark Supercharged V-8



Falcon Sprint V-8



Tempest Le Mans V-8



Corvair Turbocharged
Spyder



Olds Turbocharged Jetfire

VACATIONING ON WHEELS: 26 pages on Tent Trailers •
Camping Vans • Piggyback Campers • Car-Top Sleepers • Station-Wagon Tents

WERNHER VON BRAUN
on Observatories in Space

Now You Can Have
Hi-Fi TV Pictures

Why Sports Records
Are Toppling



If we made a Thunderbird wagon...



it'd ride like this one!

Thunderbird's fabulous ride was the inspiration for the '63 Fords. Over ten million dollars was spent in perfecting this sensational new ride. Scores of improvements were made—from new front and rear suspensions to new butyl rubber body mounts.

When these changes were tailored to Ford Wagon dimensions,

Talk about wagons...your Ford Dealer has more to talk about

something totally new came to wagon living—a ride so incredibly smooth you'll have to try it to believe it.

Among the many options: V-8 engines up to 300-hp., bucket seats, sporty 4-speed floor shift, Swing-Away steering wheel. Standard items: power-operated rear window on 6- and 9-passenger models

and twice-a-year (or 6,000-mile) service-saving features. Drive the Country Squire—or new Country Sedan—at your Ford Dealer's!

FOR 60 YEARS THE SYMBOL OF DEPENDABLE PRODUCTS



America's longest, liveliest line of wagons

FORD

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Winchester still believes 22's are real rifles.

Left: Lever action rifle Model 250, \$56.95. Center: Semi-automatic rifle Model 290, \$52.95. Right: Pump action rifle Model 270, \$52.95. Specifications: Magazine Capacity—21 Short, 17 Long, and 15 Long Rifle cartridges interchangeably. Sights—Rear: Square notch, adjustable for elevation and windage. Front: Square post on streamlining ramp. Receiver—Grooved for 10-off scope mounts. Bolt—Engine turned. Barrel—20 1/2" 1 turn in 16"—right-hand twist. Overall Length—39". Stock Dimensions—Pull—13 1/4", drop at comb 1 1/4", drop at heel 2 1/4". Weight—5 lbs., approximate.



Here are three new Winchester 22's: a lever, an automatic, a pump. Which would be your favorite small game rifle?

These are man-sized rifles. Plain hard-working guns with plenty of guts instead of fancy frills.

Here's the hefty, the feel and the honest wood-and-metal workmanship that have always placed a Winchester above the pack. These new 22's are hunting rifles, designed to deliver plenty of firepower just where you want it—for years and years and years.

If there's one word men have used most to describe why they won't be without a Winchester it's the word "honest."

An honest rifle being one that a man on a hunt can depend on—no matter how tough the going gets. When you're packing a Winchester you can be pretty sure it'll work and shoot where you point it.

That's as honest as a rifle can be. That's a real rifle. That's the only kind of rifle Winchester makes.

WINCHESTER Model 270
WINCHESTER Model 290
WINCHESTER Model 250
Olin

Next Month in Popular Science

- **The Fabulous Flying Boats.** Dramatic story of the giant planes that reigned briefly as queens of the transoceanic air lanes.
- **At Last—an Automatic Tape Changer.** Complete report on Revere's revolutionary stereo player-recorder that gives you up to 15 hours of music.
- **Jim Roe Tests the Mercruisers.** PS's boating editor wrings out the stern-drive power packages on Mercury's Lake X test center.
- **If Your Car Goes in the Water.** Astounding facts—and expert advice—on this terrifying accident that takes more than 400 lives a year.

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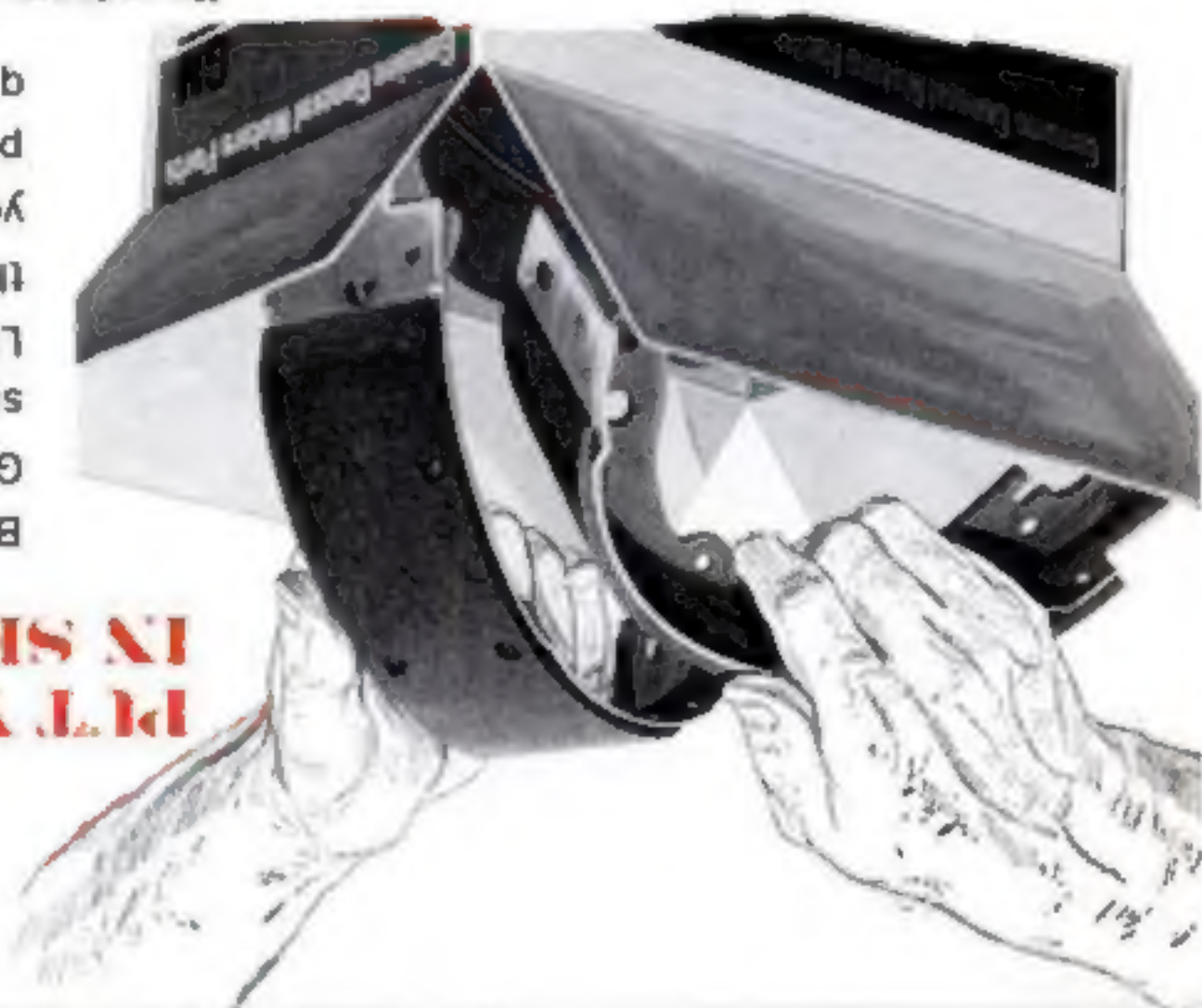
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POPULAR SCIENCE MAY 1963





Demolition Expert

This is a Mercury outboard test driver dressing for work at our Lake X, Florida, proving grounds. He's paid to try to demolish Mercury outboards. His weapons include speed, "stand-still" idling, corrosion, underwater obstacles the size of telephone poles, sand bars and different fuel mixtures (many of them wrong). One of his deadliest weapons is "full throttle time." The idea here is literally to run the motor to death.

That's what he's starting now. He and his cohorts will alternate continuous 8-hour shifts night and day. They'll lock open the throttles on two 1963 Merc 1000's at full speed. The boat will average about 55 mph continuously... stopping only to take on fuel and change "experts." Every 24 hours, each motor will log about 1520 miles.

And, when you're reading this same magazine next month, our experts will still be trying to run these same two Mercs to death.

We pay these Lake "X-perts" to make sure you'll get more RUN for your money with Mercury.

MERCURY

100, 85, 65, 50, 35, 20, 9.8, and 8 hp outboards



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100 and 39 hp diesel

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May 1963

Cover photo by Robert D. Borst



Better athletes? Or are gimmicks breaking those records? Page 58.



Under some Indy hoods: engines from Detroit. Page 75.



Vacation trip? Take a parlor, kitchen, and sink along. Page 117.

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For people who like to sit at home and knit, Tempest is not.

We could go on claiming a Tempest to be the cat's whiskers until we're blue in the face. But what's the use if you think we're just tooting our let's-sell-more-cars trumpet?



Do yourself (and your friendly car tailor—us) a favor. Amble into your Pontiac dealer's and try a Tempest. Maybe a Le Mans convertible, now that the weather's warming up.



Then reluctantly (of course) pry yourself out of its deep bucket seat and go off somewhere by yourself to do some serious thinking. Choosing the right engine (V-8 or 4?) and transmission (stick shift or automatic*?) and axle ratio and color and all that jazz isn't the work of a minute.*

When you're ready, snatch an order form from a salesman and check off what you want in your Tempest. It's the next best thing to building your own car, because we use your order as our jig, so to speak.



Unless you're one of the purl-one-drop-three brigade, strike a blow for something or other. Pack up your raveled cares (in your old knit bag?), turn on a Tempest and make off with all the fun.

*Optional at extra cost **Wide-Track Pontiac Tempest**

Pontiac Motor Division • General Motors Corporation



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PS readers talk back

45 Years Ago—in France

The 30-year-old item on new air brakes for planes ["90, 60, 30 Years Ago in PS," Jan.] tickled me. In 1918, I was test pilot at the Hanriot aircraft factory in France. Hanriot was building Spads, the Hanriot Pursuit (a nice little single-seat job), and a Sopwith nicknamed the Strutter (a two-seater biplane powered with a Le Rhone rotary engine).

While obsolete for use at the front, the Strutter was extensively used for training. It was a sweet little ship, but had a rather bad habit of shedding the wings if dived to terminal velocity.

Just outboard of the catwalk to the pilot's cockpit, on both lower wings, there was a section of the trailing edge of the wing that could be turned down so it was at a 90-degree angle from the line of flight. A large hand-wheel at right of the pilot operated these "air brakes." The flaps, as they're now called, were quite effective, shortening the landing run and takeoff by about 30 percent.

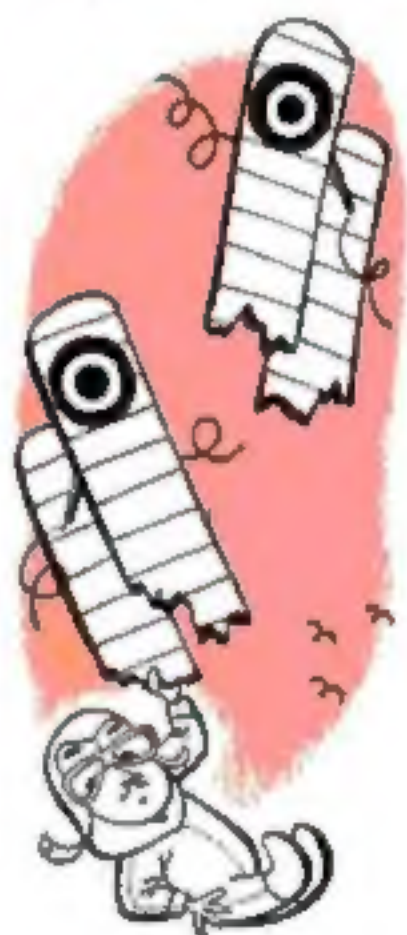
WILL T. SCOTT, Santee, Calif.

Warning for Amateur Gas Welders

"How to Get Started in Gas Welding" [Jan.], by John Burroughs, does a great disservice to gas welding and cutting. If there is one area where the home-workshop operator should be prohibited from welding, it is in his cellar workshop. In fact, any welding or cutting in a frame building should be prohibited unless under careful control of qualified personnel.

A. N. KUGLER, Chief Welding Eng.
Air Reduction Sales Co., NYC.

... The statement, "Take ordinary common-sense fire precautions and you can gas-weld in your basement with complete safety," is dangerous over-simplification. In industrial prac-





Winners' circle

Why racing "pros" prefer Perfect Circle rings—the piston rings to install for championship performance in any engine

Starting point to finish line—that's the toughest trip an engine can take. To maintain full-power performance, racing "pros" take extra care in picking engine parts. Their choice in piston rings: Perfect Circle.

PC-equipped cars have won 28 of the past 35 races at Indianapolis. Year after year, more major USAC events and NASCAR competitions are won by drivers using PC rings than any other piston ring brand.

The Perfect Circle piston rings that racing "pros" use are the *same* off-the-shelf rings you can install for championship engine performance in your car. They are not specially-made for racing. What does make them special is their lasting precision fit and long-life dependability in any engine.

The next time you install rings—or have them installed, be sure to stop oil loss through valve guides by installing Perfect Circle Valve Seals, too.



PERFECT CIRCLE

**PISTON RINGS • CYLINDER LINERS • PRECISION CASTINGS
TURBINE BLADES AND WHEELS • ELECTRONIC PROGRAMING EQUIPMENT
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FREE! Send for booklet on how to do many stapling jobs.

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POPULAR SCIENCE MAY 1963

tice, moving or protecting combustibles within 35 feet is recommended.

F. R. FETHERSTON,
Compressed Gas Assn., Inc., NYC.

Offbeat Recordings

In "This Is Hi-Fi?" [Mar.] you say that one man mounted his mikes alongside the tracks to record the sound of a steam locomotive. On the next page you show a picture suggesting that the most exciting train effects are obtained



by placing the microphones a considerable distance away. I'm confused.

JOHN WESCOTT, Philadelphia.

The long-distance method is a specialty of O. Winston Link, one of the foremost contributors to this field of sound recording. Link has produced five albums of "Sounds of Steam Railroading" (Railway Productions, 58 E. 34 St., NYC 16) working with real, live operating railroads. The photo shows Link in action with his star performer.

Helium—the Maverick

In "Sky-High and Starry-Eyed" [Feb.] you say that any gas experiences a sharp temperature drop when expanded. This is true except for one provision: The temperature of the gas initially must be below its inversion temperature. The inversion temperature of helium and hydrogen is well below ordinary temperatures, so the gas would actually heat up upon expansion. If it was initially at its inversion temperature, no change in temperature will occur.

LAURIE FORBES, Edmonton, Can.

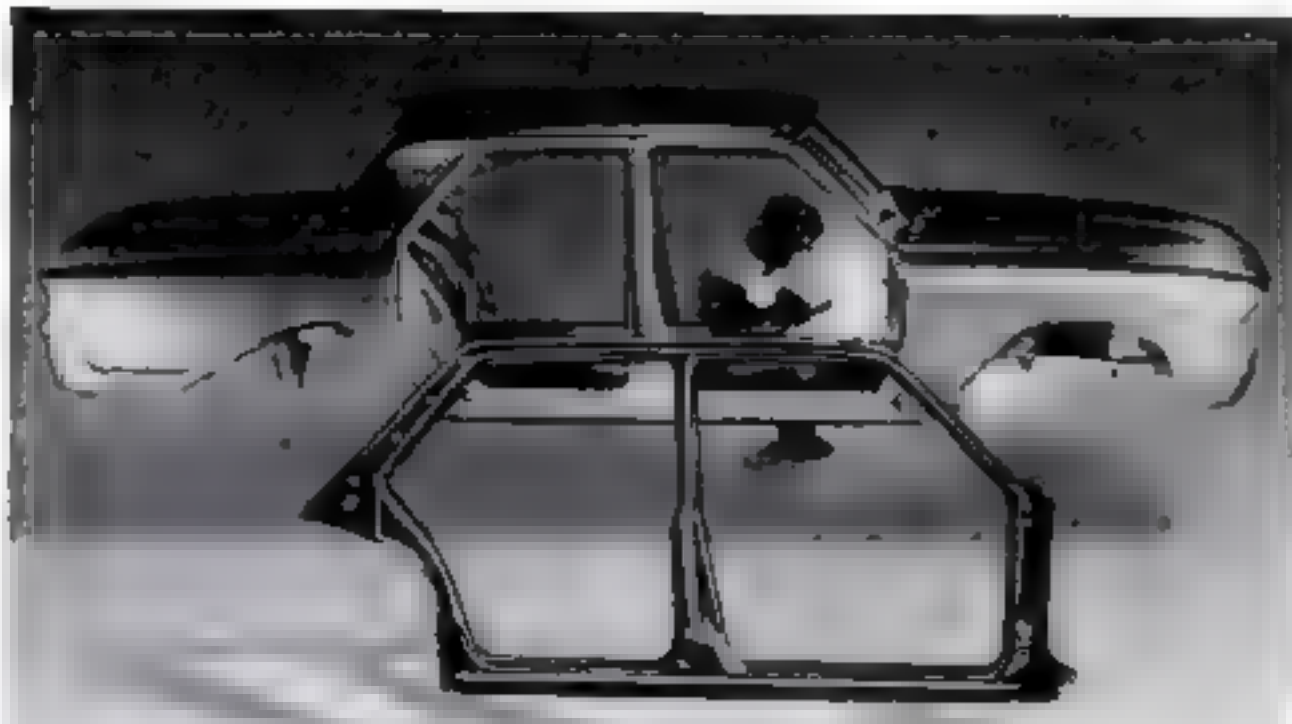
According to an expert at the Linde Co., this is true of hydrogen, within certain limits, but not of helium. So there is a temperature drop.

Rooftop Camper

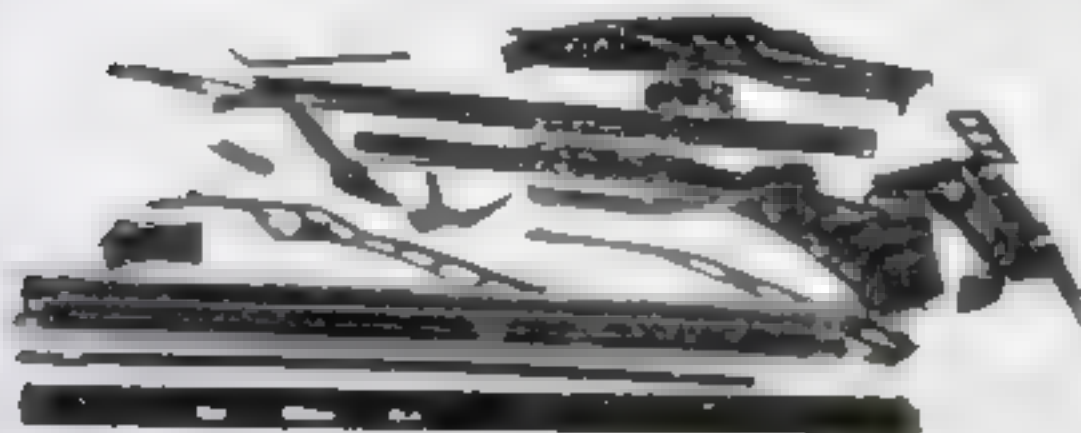
Thought you might like to see our "sleeper," built last year from PS [May '61] plans. We

CONTINUED

FROM RAMBLER—A YEARS-AHEAD BREAKTHROUGH:



RAMBLER WAY



OLD WAY

NEW ADVANCED UNIT CONSTRUCTION OBSOLETE'S "JIGSAW" BODY BUILDING

Rambler forms the outer and inner side panels of each car—the uniside structure—from massive, one-piece steel stampings. Eliminated: up to 50 separate small parts still pieced together by other car makers.

This solid uniside structure is the key to new Advanced Unit Construction, the sensational breakthrough creating new '63 Classic Six, V-8 and Ambassador V-8 models that are the strongest, tightest, most rattle-free ever built.

See Rambler '63—"Car of the Year"—at your Rambler dealer!

Look at the advantages of new Advanced Unit Construction!



You get more than enough headroom for six 6-footers in a car that's nearly 3 inches lower.



You get in and out easily because curved glass side windows let your doors curve right up into the roof.



You get a car that looks longer but isn't—is actually easier than ever to park and handle.

RAMBLER '63

Winner of Motor Trend Magazine Award

"CAR OF THE YEAR"

HIGH WAGES

for operators of heavy construction equipment

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National is NOT a correspondence school ... qualified job-experienced instructors teach you in person on over 44 million dollars worth of School-owned modern diesel-engined machines of the same type now in use by the industry. Full 220-hr. and 440-hr. courses. VA approved. Ages 17-56. Payment plans available. Full-time Job Advisory and Counseling Director for the exclusive benefit of graduates.



GRADUATES REPORT ...

New Yorker, on a project in South, says:

"... job will take at least a year to complete ... my accomplishments changed me from a \$60-a-week man to a \$150 to \$190-a-week man."

Joe E. Oppenheim
Great Neck, N. Y.

California graduate reports:

"... a new contract gives 83¢ an hr. raise over the next three years, now getting \$4.53 1/2 an hr. ... also paid holidays."

Paul Van Wattering
Van Nuys, Calif.

Eight years ago, I founded National School of Heavy Equipment Operation, the first school of its kind in the world. Since then, students from all 50 states and 28 foreign countries have been enrolled at National, and now hundreds of graduates are working in the construction field for higher wages than they ever made before!

Gilbert S. Shaw
President and Founder



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built it oversize (5'-by-9' base inside 1"-by-12" sides) to cover the steel carrier bars. It takes a full-size spring mattress and leaves plenty of storage space. Because we turned to our scrap pile, major costs were \$9 for waterproof canvas and \$13 for the carrier bars.



We used our sleeper on a 2,900-mile vacation trip last year. Many people expressed interest in the setup. We have hopes for more good times this year.

W. M. HOLDER JR., Roswell, N.M.

For 1963 "Vacationing on Wheels" plans, see the special section starting on page 117.

Where is the F-104?

"The Incredible X-15" [Feb.] carries a caption below the lead photograph that says one can see an "F-104 chase plane in the distance." The photograph shows three aircraft. One is the X-15, one is a B-52, and the other is an F-100. These are the only aircraft I can see. Where is the F-104?

JOHN M. KRIES, Denver.

That one got away. You're correct, the aircraft shown is an F-100 Super Sabre.

Dyeing Aluminum Rainbow Colors

Readers interested in "How to Anodize Aluminum" [Feb.] can get all the acid they need at about the right strength and without cost from gas stations or anywhere car batteries are sold. The acid in trade-ins is eventually dumped. A hydrometer is convenient for removing and collecting the acid in a plastic bleach bottle, and for checking the gravity — you may need to add distilled water. A reading of 1,100 corresponds to 14.35 percent by weight, very close to the 15 percent the article suggests.

A table giving the hydrometer reading for any desired percentage solution of sulfuric acid will be found in the "Handbook of Chemistry and Physics of the Chemical Rubber Co."

ARTHUR MILES, San Diego, Calif.

Back to the Races

Keith Vining's references to average speeds of the Indianapolis 500 and the Daytona 500 ["Detroit Goes Back to the Races," Feb.] are

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Wherever You Go!

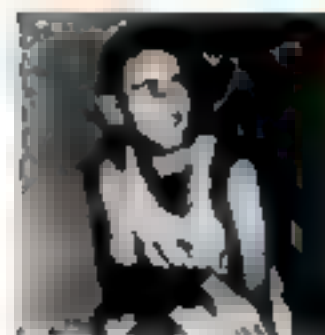
It's nice to know that, wherever you go, you have "a friend in town" . . . the Harley-Davidson dealer. Stop in for a chat; for directions; for service; for answers to your questions about motorcycle performance; or for information about local motorcycling activities. You'll find the Harley-Davidson dealer is genuinely interested in you . . . that his unmatched motorcycling know-how and the very best in service

are yours for the asking. Stop in soon. Let your Harley-Davidson dealer round out your riding pleasure with this exclusive combination:

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MAKE	YEAR
MAKE	YEAR
MAKE	YEAR

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NAME
STREET
CITY STATE

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misleading. The Indy track's turns (laid out in 1909) are not mathematically banked, making it difficult to negotiate them. Still, Parnelli Jones broke the one-lap and four-lap qualifying records in 1962 with an average of 150.3 m.p.h. The highest speeds reached on the track are around 180 m.p.h. at the end of the backstretch.

TOM BURCH, Indianapolis.

Junior Johnson of Ronda, N.C., drove a '63 Chevrolet one lap at Daytona on Feb. 21 at 168.6 m.p.h., and Tiny Lund in a '63 Ford averaged 151.8 m.p.h. for 500 miles there on Feb. 24, despite the fact that 35 miles were run under the caution flag.

They're Studying Curves

Your picture of the parabolic building at the Los Angeles airport [Feb., p. 95] was brought



in to my math class by one of the students. I was pleased that you mentioned the curve used. This particular article appeared just as we were studying quadratic curves and their relation to the conic sections. It made good illustrative material for our bulletin board.

R. E. KOHMAN, Wellsville, N.Y.

Fixing a Fouled Rocker-Arm Oil Line

In your handy "Hints from the Model Garage" [Feb.], there's one on running a line from the oil filter to the head. I have found that a copper oil line with an elbow fitting into the head works much better than a flex line. The flex line has a tendency to crack where it bends to go into the head block, and also makes for a fuller oil flow.

ROBERT B. RYAN, Torrance, Calif.

First Giz—Homemade?

"Now . . . Automatic Turning for Your Lathe," [Feb.] would give the impression that the Giz is new. I made one of these in '23 or '24. It worked so well that one of my neighbors borrowed it and I haven't seen it since. The only difference was that I made mine for less than \$25.

J. VAN CANNEYT SR., Danbury, Wis.



GLENN'S NEW AUTO REPAIR MANUAL 1963 Edition

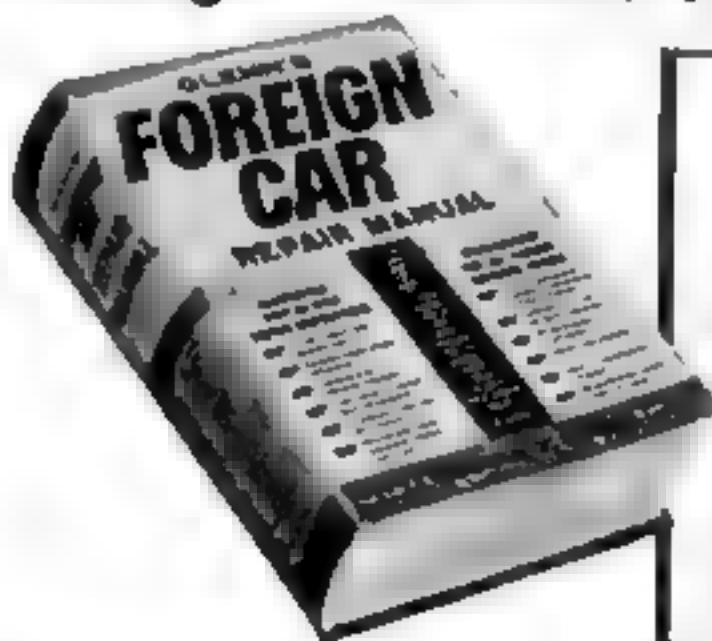
FIX THESE CARS:

Avanti	Chev II	De Soto	Lancer	Mercury
American	Chrysler	Dodge	Lincoln	Rambler
Buick	Comet	Fairlane	Mercury	Studebaker
Cadillac	Corvair	Falcon	Meteor	Tempest
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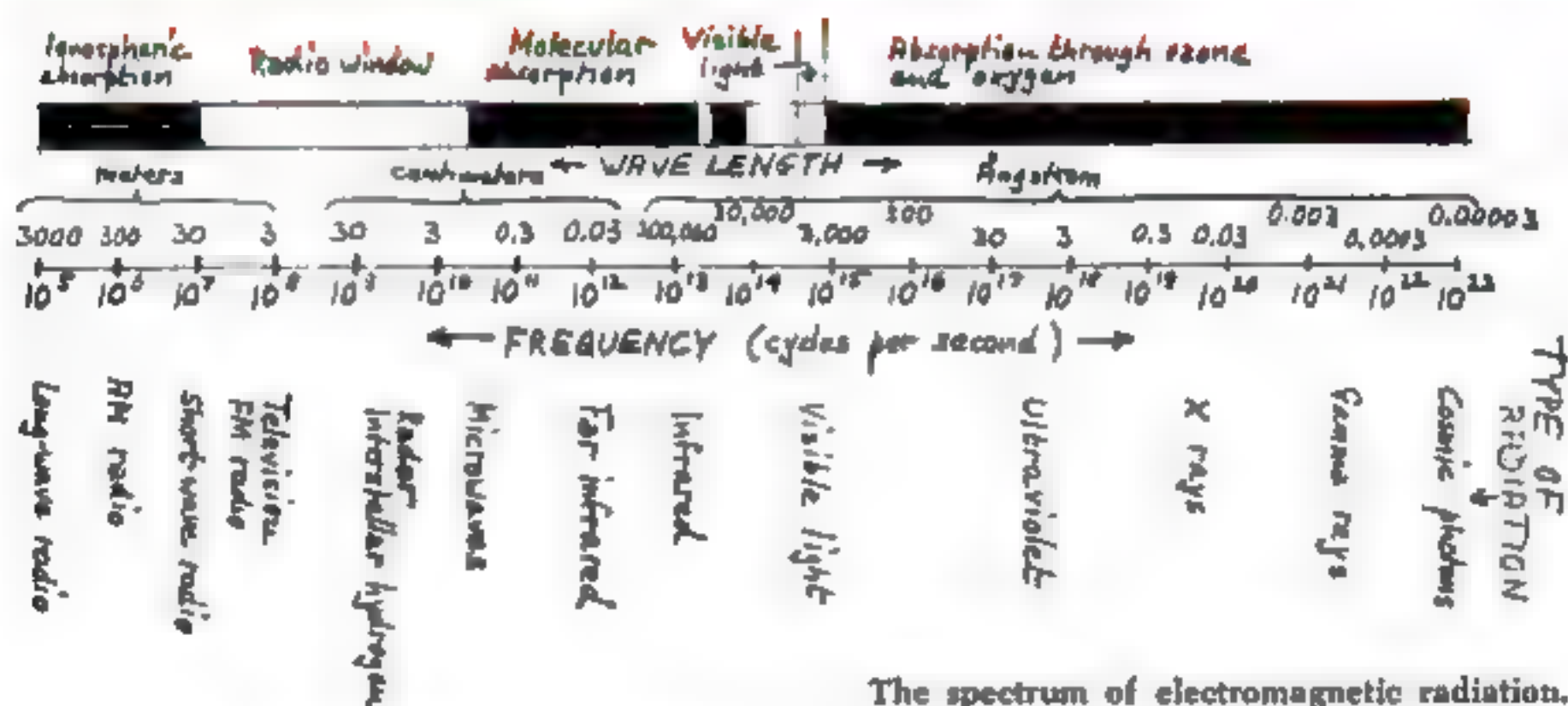
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Dr. von Braun (right) confers with Harrison Storms Jr., chief of Apollo project at North American Aviation.

Dr. Werner von Braun Answers Your Questions About Observatories in Space



The spectrum of electromagnetic radiation.

Q Why are space vehicles used to study extraterrestrial radiation?

A Radiation from stars, nebulae, and distant galaxies provides the only clue to understanding them.

Outer space is pervaded by their entire spectrum of electromagnetic radiation, shown in my diagram. It ranges in wave length all the way from 0.00003 Angstrom (an Angstrom is one ten-billionth of a meter) up to 3,000 meters. The corresponding frequencies also are shown in the diagram.

But we live at the bottom of a dense atmosphere that absorbs most of this radiation, and so is opaque to it. Only a small portion penetrates to the earth's surface. In essence, our atmospheric shell provides only two "windows": one

for visible light (with wave lengths of 4,000 to 8,000 Angstroms) and a bit of the infrared, and the other for radio waves (between about one centimeter and 30 meters in wave length).

For centuries, astronomical observations of celestial objects were limited to the narrow window admitting visible light. In recent years, radio telescopes have opened the "radio window" and gleaned much new information.

Space vehicles, operating outside the earth's atmosphere, can observe the entire spectrum of electromagnetic radiation. Manned or unmanned, they offer an ideal platform for studying the universe, with radiation-sensitive instruments that cannot be used on earth. Even a casual glance at the little diagram shows that these new observational



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tools are bound to multiply our knowledge of the universe.

Q *What practical use can we foresee for such studies?*

A We expect plenty.

Nothing is more difficult to predict than the profitable applications of a new discovery. But in the last analysis, all the things that fill our everyday needs—the food we eat, the clothes we wear, the automobiles we drive—are the result of someone's desire to explore the unknown. The harnessing of nuclear power, whether in the atom bomb or in a power-generating reactor, can be traced back directly to astrophysical studies—of the sun, in particular.

We should always bear in mind that all plant and animal life on earth would be extinct within a few hours if the sun suddenly ceased to shine.

A better understanding of the mechanism of energy transfer from the sun to the earth will undoubtedly lead to a better understanding of everyday problems down here on earth.

Q *What are we trying to learn from solar radiation?*

A The sun is our most powerful source of stellar radiation. We can consider it the nearest fixed star. Because of the window problem, we still know very little about solar ultraviolet and X-ray radiation. But what little we have learned so far from artificial satellites clearly indicates that some of the previous ideas held by astrophysicists—particularly about the intensity of ultraviolet emissions of hot stars—have been woefully wrong.

We are still completely in the dark about the causes of the sun's mysterious 11-year sunspot cycle. Scientists have known for years that there is a close correlation between this sunspot cycle and the earth's magnetic variations and polar lights. The discovery of the Van Allen belt has provided some clues for the mechanism of this interaction. But

we simply do not know what causes the sun to "breathe" in that cycle.

Conceivably, part of the heat energy continuously released by the huge nuclear reactor operating in the sun's interior, instead of flowing evenly outward to the surface, may be dammed up in some fashion so that it comes through in rather gentle periodic surges.

Variable stars with great changes in brightness are quite common in the universe—and it is fortunate indeed that our own sun's cyclic variations are so small that 100 years ago it was not even known they existed. They went undetected for so long primarily because the sunspot cycle is not accompanied by any noticeable variation in visual brightness—in other words, as observed by visible light.

It can be expected that in the hitherto inaccessible ultraviolet region, very noticeable fluctuations will be recorded.

NASA's orbiting solar observatories will be equipped to record such radiation data. But for results we must be a bit patient. We'll have to wait for the length of at least one 11-year cycle.

Q *Is there any connection between the sunspot cycle and the weather?*

A Yes. Meteorologists have learned, to their dismay, that the statistical accuracy of their predictions is adversely affected by increased ultraviolet radiation from the sun.

The reason for this is easy to understand: The art of weather forecasting is based upon the principle of causality. In other words, the U. S. weather map for Tuesday is a direct logical deduction from the trends depicted on the weather map for Monday. But such cause-and-effect reasoning is permissible only as long as one analyzes a "closed system," such as an atmosphere subjected solely to internal disturbances, while exposed to a steady, unvarying influx of solar radiation. As soon as the situation is altered by external factors—such as unrecognized changes in solar ultraviolet radiation—the beautiful causal



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reasoning falls apart, and the results of weather predictions become disappointing.

Today there is no operational, round-the-clock, satellite-borne recording system for solar ultraviolet radiation. But within a few years we shall have it. Along with making a continuous survey of the atmosphere's ozone layer (which goes up to 60-mile altitude and can be reached with simple rocket probes), it will enable meteorologists to pin down exactly those external influences on our weather. Tiros and Nimbus-type satellites with their TV cameras will keep a watchful eye on the earth's ever-changing cloud patterns, too.

Once all these new sources of knowledge are tied in with the existing weather stations, by a rapid-fire global communications system, we can rightfully expect weather forecasting to reach new heights of accuracy.

Q What is cosmic radiation?

A The term cosmic radiation, or cosmic rays, is used for elementary particles that crisscross outer space at velocities approaching the speed of light.

The majority of these particles are protons, the nuclei of atoms of hydrogen (atomic weight, 1). But heavier nuclei up to those of indium (atomic weight, 114.8) have been detected. By and large, the particle count diminishes with increasing particle weight, but some heavier elements such as iron (atomic weight, 55.8) are relatively abundant. Although evidence is still a bit sketchy, some scientists believe that the atomic-weight distribution of cosmic rays reflects the relative abundance of the chemical elements throughout the universe.

This has led to the theory that cosmic rays might be the debris of tremendous thermonuclear explosions of stars. Such exploding stars have been observed by astronomers and are called *supernovae*.

However, some cosmic-ray particles travel so fast that even a supernova explosion could not account for their en-



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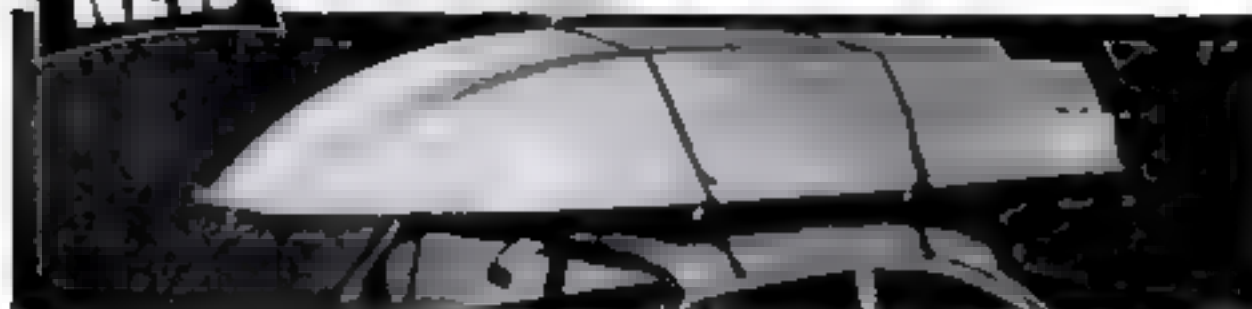
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ergy. It is believed such high-energy particles derive their extra speed from being bounced back and forth, between the magnetic fields that accompany vast, moving interstellar clouds of extremely tenuous ionized gas or *plasma*.

Cosmic radiation of a lesser energy level is known to come from the sun, particularly during solar flares. Such lower-energy particles approaching the earth are deflected, by the earth's magnetic field, toward the North and South Poles. Thus, total cosmic-ray intensity is at a minimum over the earth's equator.

Cosmic-ray particles as encountered in outer space are often called *primaries*, to distinguish them from the cascade of secondary particles generated by their collision with air nuclei in the upper layers of our atmospheric shell. These secondary particles shower down through the atmosphere. Although their intensity tapers off with decreasing altitude, they can be detected at the ground and even several hundred feet under water.

The question of the physiological hazards of cosmic radiation to astronauts is still hotly debated. Surprisingly, radiologists are not concerned about the most energetic primary particles. These go through the human body so fast that they have no time to do damage.

The greatest potential hazard is posed by a slow, heavy primary that comes to a "screeching halt" in the human body. In this case the positively charged primary particle has time enough to jerk a whole string of electrons out of the atomic shells of the body tissue, along the path of its "terminal retardation," or final braking. Some radiologists believe that certain areas of the human body, such as the brain and spinal cord, might be endangered by extensive exposure to such "slow-down hits." Hence they are advocating extra radiation protection for longer space flights. ■ ■

.....

Dr. von Braun will consider answering questions from readers of *POPULAR SCIENCE* in the magazine, but he cannot undertake to answer each one by mail. Letters to him should be addressed in care of *POPULAR SCIENCE*, 355 Lexington Ave., New York 17, N. Y.

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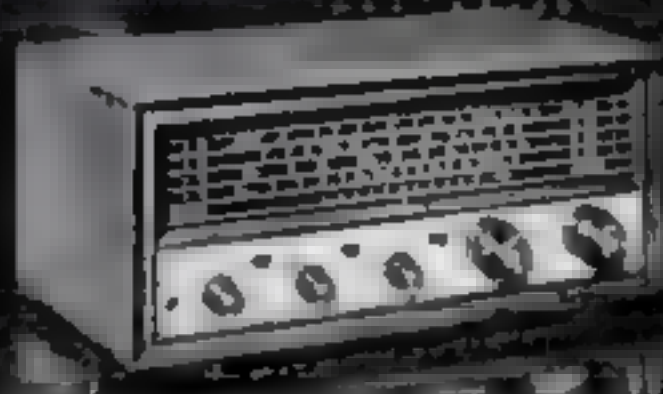


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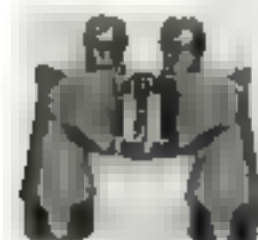
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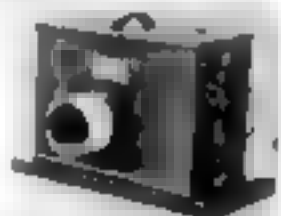
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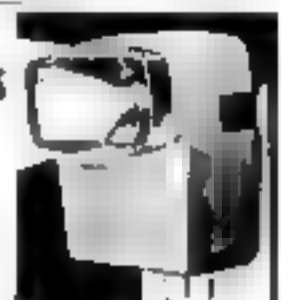
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Science newsfront

BY WALLACE CLOUD

A monthly report: What's going on in science and why it's important to you

SPACE

What did we learn about Venus?

The lead article in *POPULAR SCIENCE* last December was "Keeping a Date with Venus," a report on the U. S. interplanetary probe Mariner 2, then approaching its destination. Mariner kept its date on December 14 and scanned Venus with instruments designed to see through the planet's blanket of clouds. Then came months of waiting, as the data was deciphered and released piecemeal.

What sort of place is Venus? Even with the results in, the experts disagreed about their meaning. After consulting scientists at NASA's Institute for Space Studies, Harvard University, and the Lamont Geological Observatory, we tried our own hand at working out a picture of conditions on Venus. Our version, illustrated by artist Ray Ploch, is at the right.

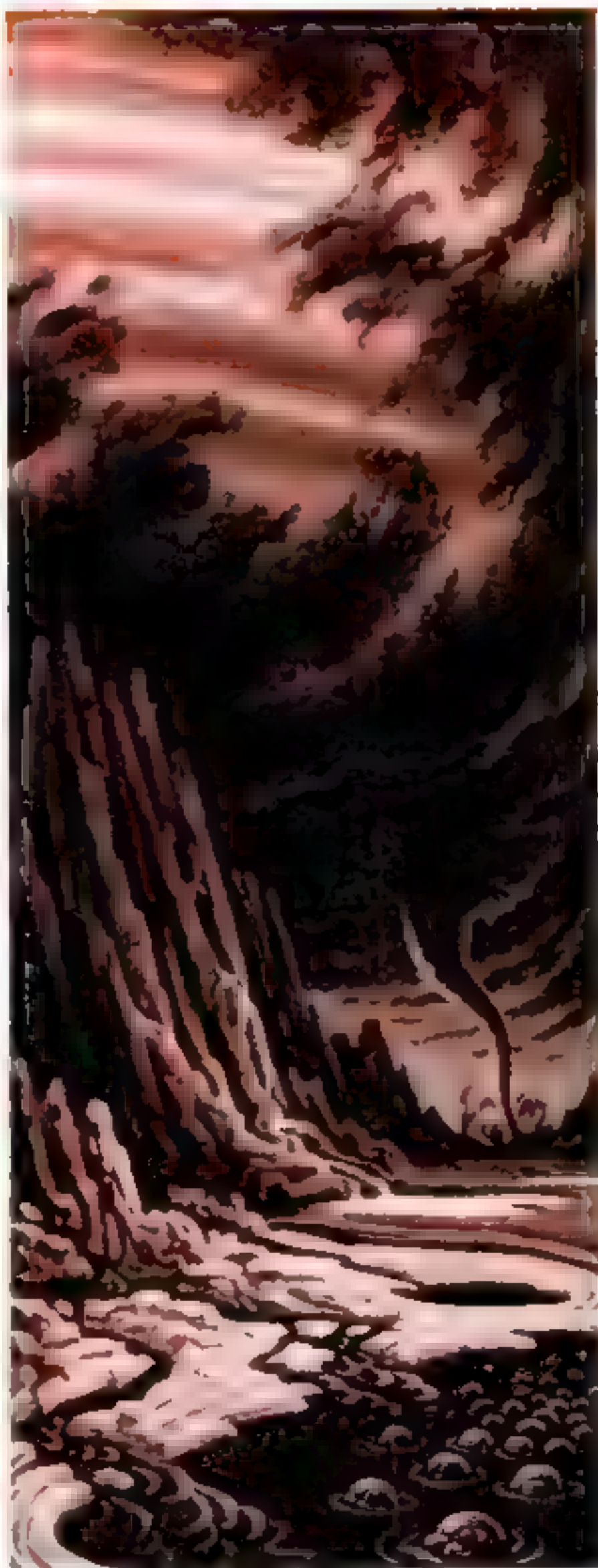
Beneath its perpetual heavy overcast—consisting of two cloud layers, 25 and 40 miles up—Venus is a searing furnace.

The sun, if it is ever visible through breaks in the clouds, is brick red; the sky is yellowish green. These colors result from the great density of the atmosphere (which may be largely carbon dioxide)—pressure at the surface is somewhere between 10 and 50 times that of our atmosphere.

Even at that pressure, there can be no liquid water, since the temperature is about 900 degrees F. on the sunlit side—so hot the rocks may glow feebly with the beginnings of red heat—and is near 700 degrees on the dark side.

But there may be other liquids. The temperature is above the melting point of lead. Perhaps molten soft metals and molten salts ooze from the rocks. Heavy hydrocarbons somewhat like asphalt may also exist in liquid form.

These would vaporize to form the lower cloud layer, which may be an oily, smoky smog consisting of hydrocarbons and their oxidation products (in which the planet's free oxygen was locked up long ago).



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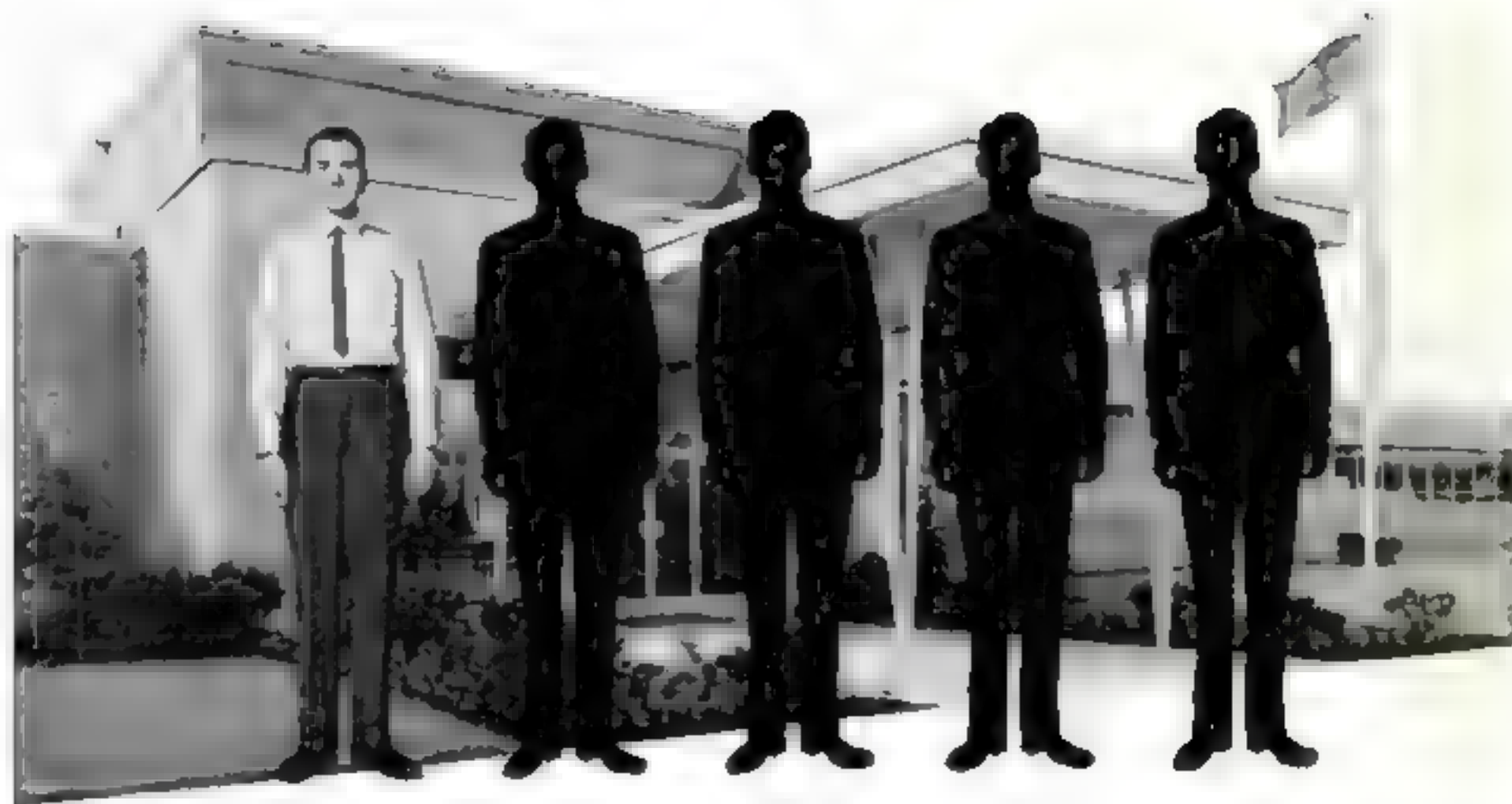
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Science newsfront continued

The weather may be violent. If it rains, the rain would be oily, reaching the ground as hot mud after mixing with dust stirred up by high winds. Circulation of the atmosphere would be turbulent, due to the temperature range. The upper cloud layer,

Van Allen changes mind. The artificial radiation belt around the earth, created by last summer's U.S. H-bomb test high over the Pacific, is "very durable indeed" and may last "for a decade or so," concedes Dr. James A. Van Allen, discoverer of the earth's natural radiation belts. He has been involved in a controversy about the belt. In an interview published in this magazine last month, Dr. Van Allen held the position that the artificial belt would be undetectable by this summer, as he had predicted before the H-bomb test.

thought to consist of ice crystals and liquid droplets, has an outer temperature of about 80 degrees below zero, comparable to the temperature of the earth's upper atmosphere. Atmospheric circulation must also transport enough heat to account for the high temperature of the dark side, in view of the planet's slow rotation.

New information on the rotation of Venus came from radar experiments conducted during the time of the Mariner flight. Scientists at Jet Propulsion Laboratory found that the planet turns so slowly that it may always keep the same face toward the sun, or may even rotate *backwards* (in a direction counter to its orbital rotation) once every 250 earth days. That would make the sun rise in the west and set in the east roughly twice during a Venus year, which is equivalent to about 225 earth days.

Slow rotation explains one of Mariner's most important observations: absence of a detectable planetary magnetic field in space near Venus. Most physicists think the earth works like a dynamo; as it spins, electric currents are induced in the earth's liquid iron core, generating a magnetic field. So it's entirely logical that slowly turning Venus, also presumed to have a liquid core, has little or no magnetic field.

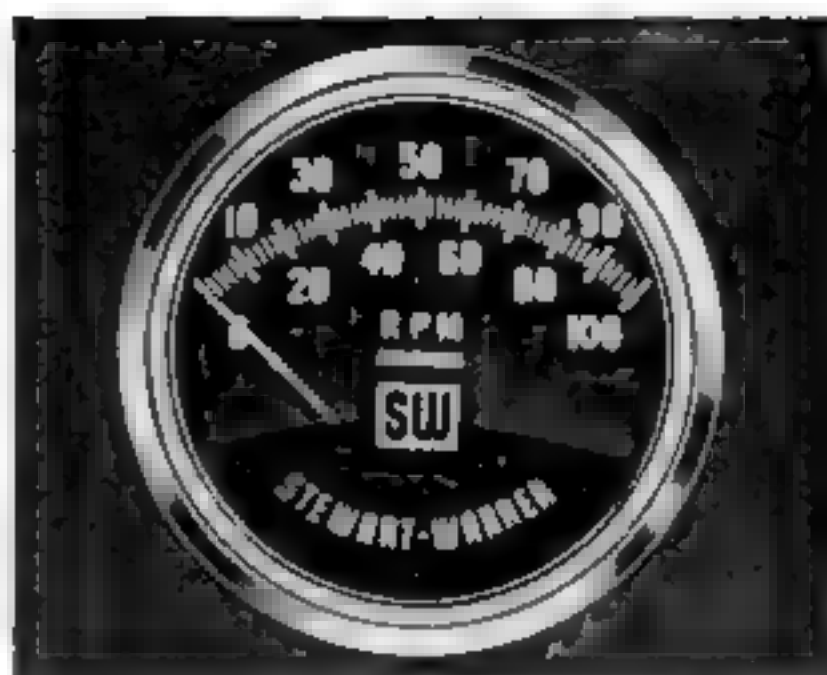
Lack of a magnetic field also checks out with Mariner's inability to detect any radiation belts around Venus, another contrast with our own planet. The earth's magnetic

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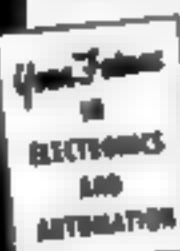
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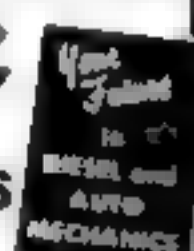
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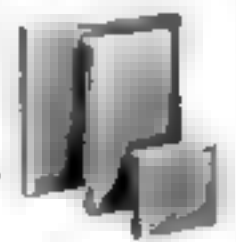
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Science newsfront continued

field traps charged particles in space, producing the familiar Van Allen belts.

Mariner's most puzzling observation was another negative one—absence of micrometeorites, or cosmic dust, in the space path to Venus. During 1,700 hours of operation, the micrometeorite detector registered only two dust-particle impacts, both far from Venus. In a similar period, a detector near the earth would have recorded thousands of impacts. If verified in the future, this may indicate that the earth's orbit passes through an unusually dusty part of the solar system.

By raising this perplexity, and by answering some questions but not others, the highly successful Mariner experiment left the mystery of Venus still unsolved. Before Mariner was dispatched, it was already known with reasonable certainty that Venus was too hot for comfort. The major scientific controversy about Venus concerned the question: Why is it so hot? Two conflicting theories still stand unshaken.

One is the greenhouse theory. According to this idea, the cloudy atmosphere of Venus is relatively transparent to the sun's rays, which are absorbed by the planet's surface and converted to heat. The heat is re-radiated outward, but as infrared that's

High living. Shaving during long space flights is a problem being studied by U. S. space scientists, according to Dr Stanley C. White of NASA. Beards are unsanitary, you see. Water is precious in a space capsule, so an electric razor might be a good idea. But the motor sparks, creating a fire hazard in the 100-percent-oxygen breathing atmosphere. Then there's the problem of fuzz-capture. In the weightless state, whiskers shaved off will float around, and a fog of stubble will permeate the space cabin.

blocked by the atmosphere. Like the glass roof of a greenhouse, the atmosphere of Venus lets sunlight in but keeps heat from getting out. So the temperature builds up inside.

The competing idea is the dust-bowl theory. This says that the main effect of the sun's rays is to produce convection currents in the atmosphere of Venus, creating violent winds and dust storms. A dust cloud 20 miles deep covers the planet. Like sand-

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Science newsfront continued

paper, the agitated dust cloud heats the surface of the planet by friction.

Until one of those theories is laid to rest—if one of them is correct—the exploration of Venus is not even half finished.

It may even be too soon to say flatly that there's no life on Venus. Obviously, life as we know it—or as we can imagine it—can't exist in that furnace. At such high temperatures, chemical reactions proceed rapidly; the reactive elements needed by life are already locked up in stable, refractory end-products of chemical reaction; and the fragile, complex molecules that are typical of life don't stand a chance. Any life form that could survive would have to be based on an extremely aggressive chemistry, with a strange metabolism indeed. But it's hard to be sure that no such life form exists.

Perhaps someday we'll be able to land a rugged, heatproof television camera on the surface of the planet and really take a look around. Fragile man may even land on Venus—if he can design a suitably air-conditioned spaceship.

Hiroshima results. Returning from a two-year study of the effects of atomic radiation on the survivors of Hiroshima, Dr. Stuart C. Finch of Yale reported that cases of leukemia and thyroid cancer increased, as predicted. Contrary to expectations, though, a study of 70,000 pregnancies among parents exposed to radiation showed no increase in malformations or other genetic defects. Curiously, the boy-girl ratio of offspring was altered, depending on which parent was irradiated. If the father was exposed, a boy was more likely to be born, but more girls were born to mothers who were exposed.

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Science newsfront continued

tion to generation [see "DNA: It Calls the Signals for Life," page 66]. Both of these chemicals have long chainlike molecules capable of recording information because they are made of units that can be arranged in many different sequences, like beads of different colors on a string.

High concentrations of RNA have been found in nerve cells. And in an experiment at McGill University, Montreal, Dr. D. Ewen Cameron found that both injections and oral doses of RNA improved the memories of aged patients suffering from memory loss.

The most conclusive evidence comes from experiments with planarians—aquatic pond worms, half an inch long, with crossed eyes and very simple brains. Worms can't learn much, but a few years ago biologists found out how to condition planarians, like Pavlov's dogs. The worms, which normally respond to mild electric shock by contracting their bodies or turning to the side, were conditioned by turning a light on just before the shock was administered. After a while, they cringed in response to the light alone. Other planarians were trained to run a simple maze in order to get to water.

One of the planarian's idiosyncrasies is that if you cut him in half, his head will regenerate a tail and the tail will grow a new head. Dr. James V. McConnell of the University of Michigan trained some planarians, then cut them in half and threw away the heads. The tails grew new heads, but the worms retained some of their earlier learning. Then McConnell chopped up trained worms and fed them to untrained worms. The cannibals evidently absorbed some of their victims' education. They learned their task more easily than worms on a less exotic diet.

Was RNA at the bottom of it all? To find out, Dr. William C. Corning of the University of Rochester cut some trained planarians in half, then allowed the tails to grow new heads in a weak solution of an enzyme that destroys RNA. After the heads had regenerated, the worms had amnesia. They no longer retained any of their training.

Experiments with planarians are continuing in a number of laboratories. This promising line of research shows how well the techniques of classical biology combine with those of the new "molecular biology."

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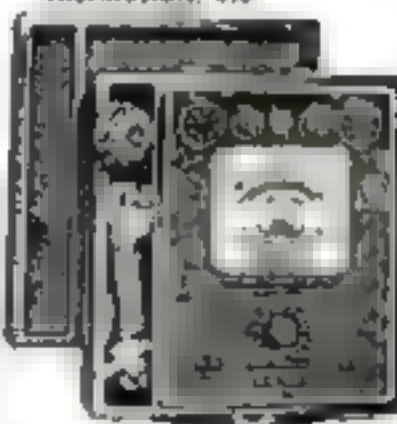
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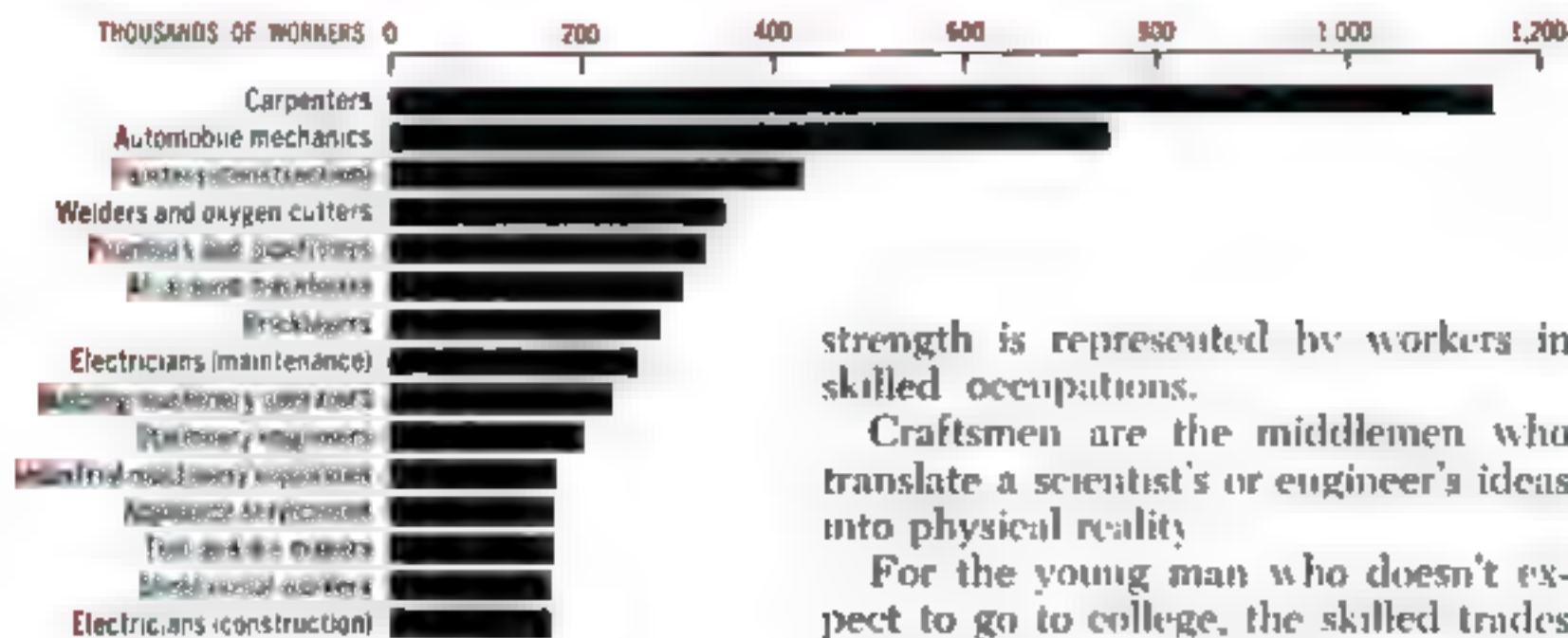
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Getting Ahead By Dr. Lewis R. Fibel

A monthly column to help you prepare yourself for a better job



There are more than a million carpenters in the U.S., more than 700,000 auto mechanics, more than 400,000 construction painters. These figures, and the others in the chart, point up how large a segment of America's industrial

strength is represented by workers in skilled occupations.

Craftsmen are the middlemen who translate a scientist's or engineer's ideas into physical reality.

For the young man who doesn't expect to go to college, the skilled trades offer good pay, a secure future, and an opportunity for a rewarding career. There is every indication that the need for skilled workers will continue to grow in the decade ahead.

(Source: Bureau of Labor Statistics, estimated figures for 1960.)

The need for chemists will almost double in the next 10 years, according to the Manufacturing Chemists' Association. In 1970 the industry will need over 150,000 scientists and engineers.

A comprehensive account of career

opportunities in chemistry was given in the Jan. 28, 1963, issue of *Chemical and Engineering News*. Copies are available at 25 cents from the Reprint Department, American Chemical Society, 1155 16th St., N.W., Washington 6, D.C.

"I am a sophomore in high school and I'd like to be an architect. What colleges are best and what are the tuition costs? I am also thinking about entering the armed forces. Which should come first? Would any specific service in the armed forces benefit my architectural career?"—T.K., Kimberton, Pa.

There are 51 schools of architecture in the U.S. accredited by the National Architectural Accrediting Board. You can get the list free from the secretary, Thomas K. Fitzpatrick, School of Architecture, University of Virginia, Charlottesville. The following Pennsylvania colleges are included:

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Pennsylvania State University, University Park (\$480 for state residents).

University of Pennsylvania, Philadelphia 4 (\$1,250).

By the time you're ready to attend, the tuition costs may be higher. In addition it will cost a minimum of \$1,500 annually for room, board, and other expenses.

It's hard to generalize about the desirability of entering the armed forces before or after college, because so many personal factors are involved. On the one hand, the more specialized education you have under your belt, the better your chances of serving in that specialty in the forces. On the other hand, the more recent your education, the better prepared you are to enter your profes-

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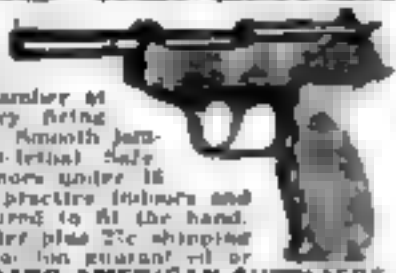
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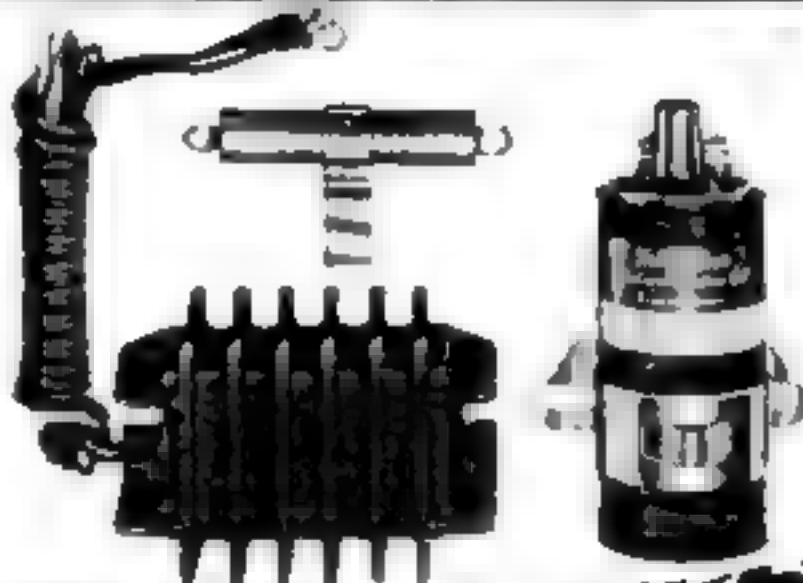
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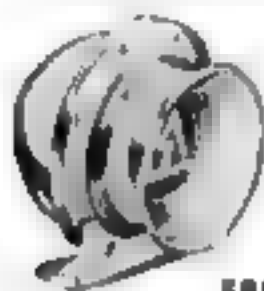
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"What are the prerequisites for becoming a computer programmer? What is the future? Is there a possibility that the computer may eventually replace the programmer?"—C.A.H., St. Louis, Mo.

Most programmers are picked for their jobs because they have an aptitude for the work and have had some experience relating to the problems to be programmed. Requirements vary. Courses are given in a number of colleges and universities, as well as in business schools. Prospective programmers should enjoy using reasoning skills, and be patient and persistent. They should be able to work with great accuracy.

There should be thousands of new jobs created in the next few years as more and more firms use computers to process business records or to control manufacturing processes.

Your last question is a fascinating one. Computers inevitably will become more sophisticated and take over increasingly large segments of human work, but I always see "a man behind the machine." I think you need have no qualms about the availability of jobs in the foreseeable future.

"I am still in high school, but I plan to make a career of either meteorology or electronics. What are the best courses to take in high school and college?"—J.McL., Chandler, Ind.

For either career you should start out with an academic high-school course with as much English, science, and math as possible. A bachelor's degree with a major in meteorology is the usual minimum educational requirement for a meteorologist. Courses in physics and mathematics are also important. *Meteorologist* by A. V. Carlin (\$1, Research Publishing Co., Inc., P.O. Box 245, Boston 1) discusses the history of meteorology, the typical job opportunities, requirements, and training.

If you wish to be an electronics engineer, you'll need a bachelor's degree in engineering as a minimum.

Electronics technicians, on the other hand, can get the necessary training from technical institutes, community colleges, or from some technical schools. You might want to look at *Careers in Electronics* by J. L. Angel (\$1, World Trade Academy Press, Inc., 3 E. 48 St., NYC 17). This gives the nature



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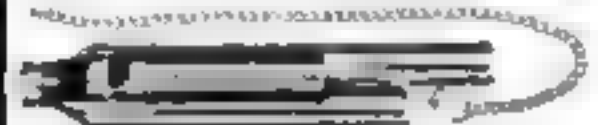
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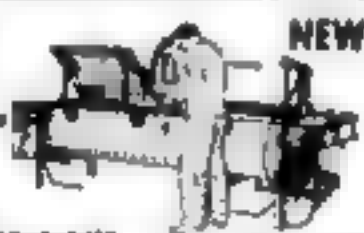
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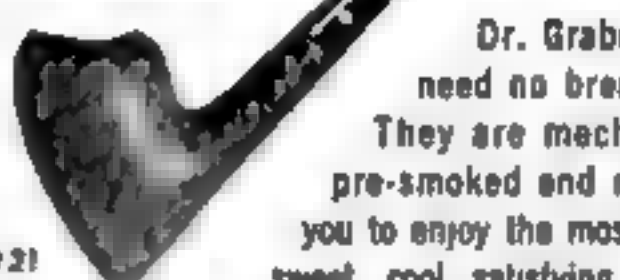
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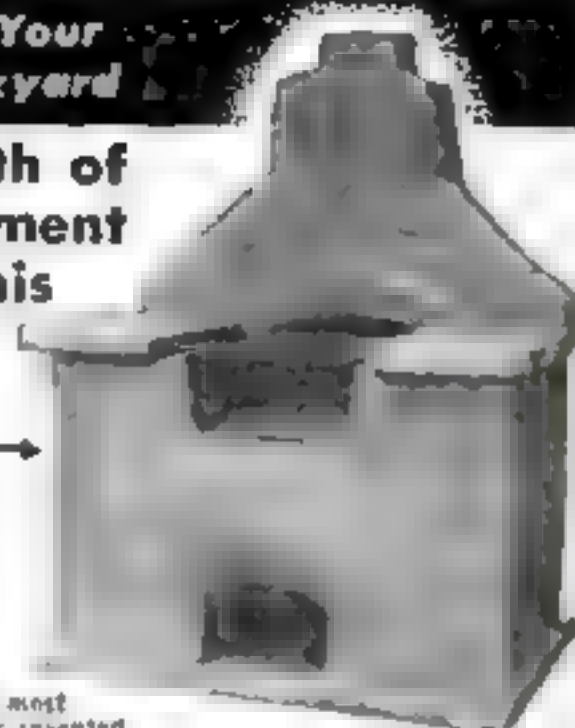
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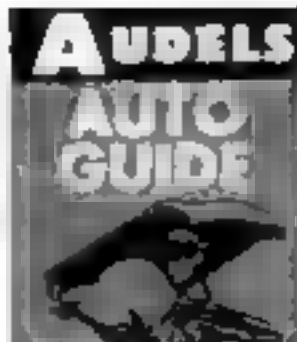
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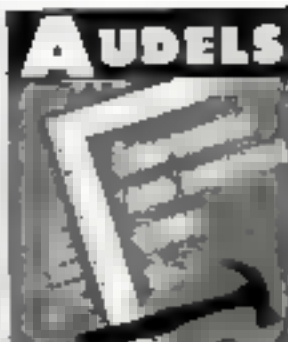
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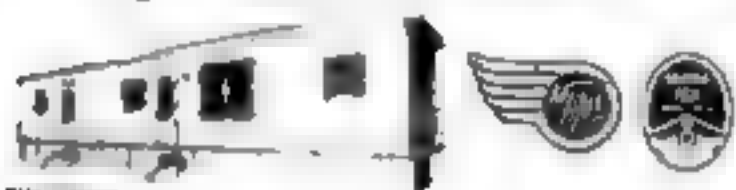
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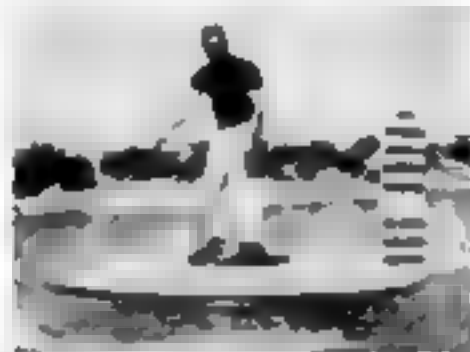
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Your Money-Making Opportunity • We want more men to go into this profitable business for themselves and enjoy independence—freedom from layoffs and bosses. Customers everywhere—homes, offices, schools, churches, hotels, etc. How much you earn depends largely on you, but we help you to start and work with you for your success. What you take in is mostly profit. No need to rent shop or office; operate from home. Can start spare time until your full time is justified.

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Detroit report

By Devon Francis

Chevy goes hot

At last Chevy has dropped its bomb-shell. For months the Detroit rumor mills had been cranking out stories about a new supersuper-stock V-8 engine under development at Chevrolet. Until now, Chevy's biggest engine had been a 409-incher, while Dodge and Plymouth had a 426 and Ford and Pontiac 427s.

At the recent Daytona Beach stock-car races, five Chevy 427-inch engines were fielded. During practice runs they burned up the track at lap speeds of up to 168 m.p.h. But mechanical troubles seemed to plague them all. None finished higher than ninth place.

Chevy is releasing no information, but a glance at the engine compartments in Daytona fetched some educated guesses. The intake manifold is unusually high, indicating a tuned system. Tuning works on the principle of a pipe organ. The passages from carburetor to intake port are of a length to set the fuel charge vibrating at a specific pitch. This builds up the momentum of the charge and gives a supercharging effect—ideally delivering the charge to the intake port just as the valve opens. The longer the passages, the lower the r.p.m. range at which the system has the greatest effect.

Exhaust headers on the new engine have individual branches from each port, and probably are also tuned. Another aid to breathing: Cool outside air is rammed through the heater plenum to the engine.

The block appears shorter than that of the 409. The heads, too, look new. The extreme width of the head covers and the side mounting of the spark plugs indicate an unusual rocker-arm configuration. There's a good chance that modified-polysphere (flattened-hemisphere)

combustion chambers and slightly inclined valves are used.

Washing machine, begone!

The gas-turbine engine in Chrysler Corp.'s coming Typhoon car will be quite different from the experimental turbines that Chrysler has demonstrated for these several years. In contrast to the "washing-machine" look of the prototypes, the production engines will be smaller and less odd-looking. Producing about 130 hp., the engines will have a "recuperator," or regenerator, on each side to recover waste heat and give added fuel economy.

Despite the slightly smaller size, the turbine's shape will require the substitution of coil springs for torsion bars in the front suspension. Side panels on the car will be smooth, and the silhouette like the Thunderbird's. There will be four bucket seats. Exhaust pipes will be pretty well hidden. They have been rather prominent on previous Chrysler turbine automobiles.

Cars by computer

Something has been going on for months at General Motors that is going to have a pronounced effect on the speed with which automobiles are improved and changed. Two dozen technicians from International Business Machines this month will complete the installation at the GM Tech Center in Warren, Mich., of one of the world's largest complexes of electronic computers and subsidiary equipment.

What have computers got to do with car design? Plenty. The revolutionary change in U.S. motorists' car-buying habits in the mid-Fifties convinced top GM executives that their system of planning for the future lacked flexibility: It took almost three years to get the first GM compacts on the production line.

The computers, to be used in engineering, styling, and research, will cut development time on a new model from 3 years to 12-18 months.



AUTOLITE-POWERED FORDS SWEEP DAYTONA 500

At Daytona, 500 miles is an eternity that lasts 3 hours, 17 minutes and 56 seconds. Engines blow, brakes fail, parts shatter without warning in this grueling test of durability.

It is a matter of record that the first five finishers, all '63 Fords, were equipped with Autolite Spark Plugs. In fact, thirty-eight of the 50 entrants in the "500" started with Autolite Spark Plugs in their cars.

Why? Tiny Lund received \$24,600 for his first-place effort in the Daytona 500. When you go for this kind of money, you don't take chances you don't have to. Tiny didn't. Drivers like Fred

Lorenzen, Ned Jarrett, Nelson Stacy, Dan Gurney didn't either. Autolite Spark Plugs have won more stock car competitions in the past year than all other makes combined for one simple reason. The men who make their living behind the wheel put them there, no matter what make of car they drive.

A faulty spark plug will probably never cost you \$24,600 as it could have cost Tiny Lund. But it costs just the same. Why not take a tip from the men who can't afford to make mistakes? Try a set of Autolite Spark Plugs in your car. The track-bred, track tested spark plug that doesn't know how to quit.

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 THE NAME TO REMEMBER WHEN YOU CARE FOR YOUR CAR

Popular Science *90, 60, and 30 years ago...*

1873 "English will become the dominant language of the world in 50 or 100 years, according to M. Alphonse de Candolle. It will be the one into which the important scientific publications will be translated. It is not only that the English-speaking population will outnumber the German and French, but that the language has peculiar merits. When people are in a hurry and want to say something quickly, it is more easily said in English.

"Our sentences don't even have to be finished to be understood, because the construction is not roundabout. The leading ideas come first."

"Prof. Leidy believes that contagion is frequently transferred by the agency of the common house-fly. His observations in military hospitals have led him to conclude that flies should be carefully excluded from wounds, particularly if gangrene is present."

1903 "At a meeting of the French Academy of Sciences MM. Curie and Laborde announced a new property of radium—its salts emit heat. Radium already possesses the power of giving out light perpetually, it can emit rays that penetrate solids, it acts on sensitized plates, and causes air to conduct electricity.

"The source of energy of the rays is a mystery. Rutherford and McClung suggest that it is due to the breaking down of atoms into smaller particles which constitute the radiations."

"The interest in the story of Helen Keller is many-sided. Born June 27, 1880, at Tuscumbia, Ala., the child was deprived of both sight and hearing by a serious illness at 18 months.

"It was through Charles Dickens' account of Laura Bridgman that Mrs. Keller became acquainted with the possibilities of education for Helen. On Mar. 3, 1887, Miss Anne Sullivan came to take charge.

"Miss Sullivan's first aim was to reveal to the infant mind the potency of a word. After some weeks, she relates:

"We went to the pump-house, and I

made Helen hold her mug under the spout while I pumped. As the cold water pumped forth, I spelled w-a-t-e-r in Helen's free hand. The word coming so close upon the sensation seemed to startle her. She dropped the mug and stood as one transfixed. She spelled w-a-t-e-r several times. All the way back to the house she was highly excited, and learned the name of every object she touched so that in a few hours the child had added 30 new words to her vocabulary."

1933 "An ultra-short wave radio has been installed at Vatican City, Italy. According to its noted designer, Guglielmo Marconi, it represents 'the first practical application of microwaves.' These waves, only 21 inches long, are a minute fraction of those used in ordinary broadcasting. They may be focused directly at the receiving station like a beam of light. The radio will be used to communicate between the Vatican and Castel Gandolfo, 20 miles away."



Marconi, left, and Pope Pius XI, right, inaugurate new microwave radio system.

"Wrapping milk or cream in paper is the unusual feat performed by a new machine for dairies. In one continuous operation the device forms a container from paper, dips it in molten paraffin, cools it, fills it with milk, and seals it. A consumer receives a boxful of milk untouched by human hands in the packaging."

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You can light
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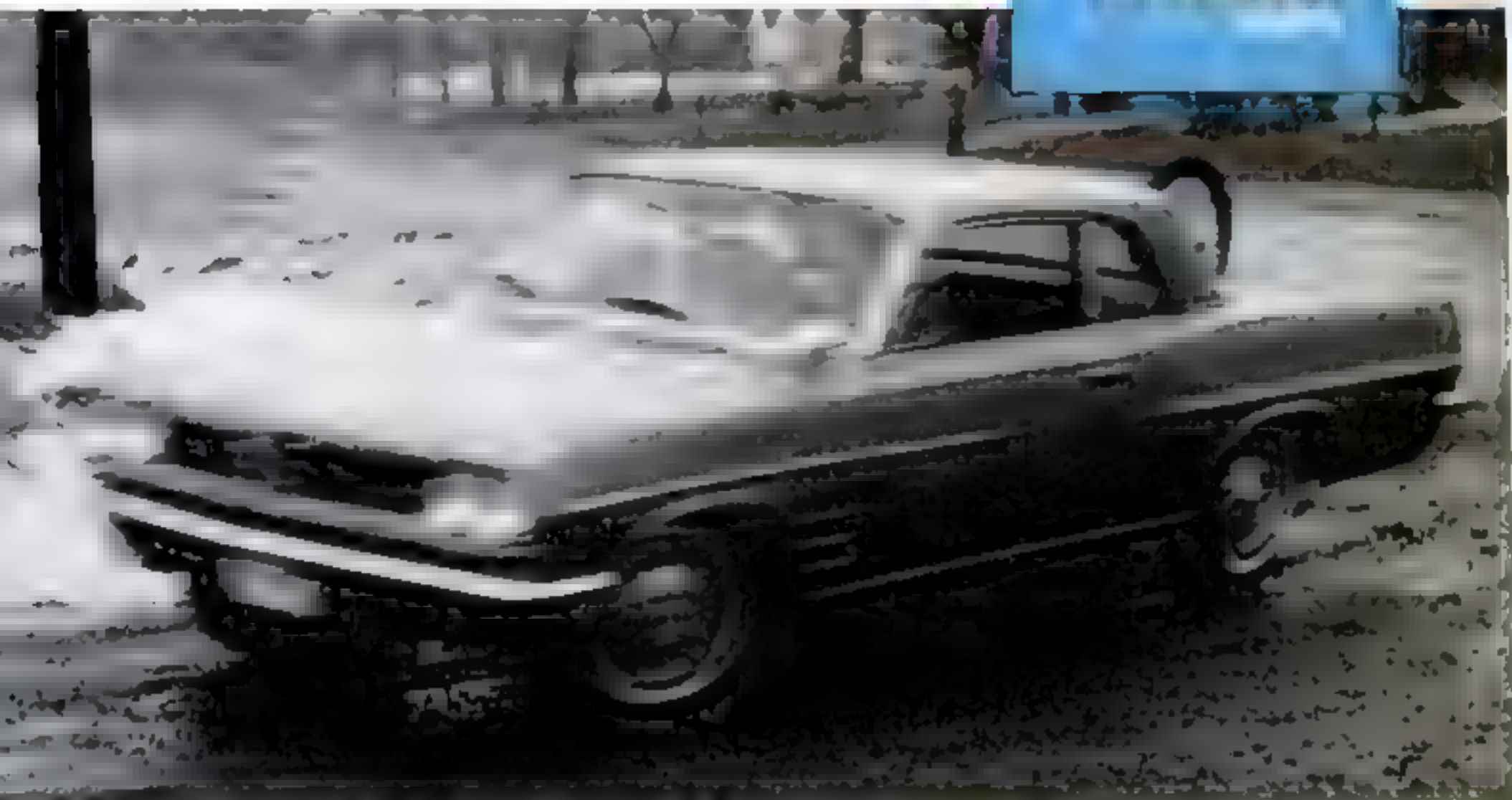
PALL MALL
FAMOUS CIGARETTES



WHICH ENGLISH
PEOPLE CONGREGATE

REPORT FROM THE DRIVER'S SEAT

Popular
Science



Five sizzlers in the U. S. small-car field were put through their paces. Above: Pontiac Tempest.

Popular Science Tests the Hot Compacts

By Devon Francis and Alex Markovich

ECONOMY was the word back in the fall of 1959 when the first covey of U.S. "compact" cars was introduced. And, as "economy" vehicles, they were shamelessly fashioned to compete with a growing flood of little cars from Europe.

In number, counting American Motors' already existing Rambler, there were four of them. As befitted automobiles of modest pretensions, they were relatively cheap, relatively small, and delivered relatively modest performances.

Since then, the list has grown. Now there are 10 U.S. compacts, and it is time to take note that some of them have been gradually growing out of their britches while nobody was looking. This is less a matter of physical size (though some are inches longer) than it is of price and performance.

They are flossier. They are heavier. They

CONTINUED



SPYDER



SPRINT



JETFIRE



TEMPEST



SUPER LARK

are becoming expensive. But the real index to their change of character lies in their power. No longer are they compacts when the light turns green. In horsepower-for-weight, they challenge and excel quite a passel of bigger cars.

To see what's happened to U.S. compacts as of this bright green spring of 1963, POPULAR SCIENCE decided to test them out. We put flow meters on their fuel lines. We put stopwatches on their accelerations. We slewed them around sharp corners to see how they rode and handled. We stood on their brakes at 80 miles an hour.

The results of these tests are shown in the chart at right and in the descriptive passages of this article. The chart also gives the vital statistics.

We chose five cars—the Corvair Spyder, Falcon Sprint, Olds Jetfire, Pontiac Tempest, and Studebaker Super Lark. These cars are all special models, or incorporate special options. Lower-powered and less costly versions of each of these cars still remain the manufacturers' standard offering.

Not chosen were the Rambler or its sister, the American, the Plymouth Valiant, Mercury Comet, or Buick Special. By its own testimony, American Motors is not in the performance business (although a smaller version of its Ambassador V-8 engine has drifted down to its Classic). The Valiant remains essen-

CONTINUED

MODEL
FACTORY-SUGGESTED PRICE (A)
ENGINE: TYPE
CARBURETION
HP. @ R P M
TORQUE (LB. FT.) @ R P M
BORE & STROKE (IN.)
DISPLACEMENT (CU. IN.)
COMPRESSION RATIO (1)
WEIGHT (LB.) PER HP
ENGINE REVS. PER MILE
PISTON TRAVEL PER MILE (FT.)
FUEL REQUIRED
FUEL CAPACITY (GAL.)
CRANKCASE CAPACITY (QT.)
TRANSMISSION TYPE AND RATIOS (1) (D)
AXLE RATIO (1)
STEERING RATIO (1) AND TURNS LOCK TO LOCK
BRAKE SWEEP AREA (SQ. IN.) AND MATERIAL USED
TIRE SIZE
WHEELBASE (IN.)
TRACK: FRONT AND REAR (IN.)
GROUND CLEARANCE (IN.)
CURB WEIGHT (LB.)
WEIGHT DISTRIBUTION FRONT AND REAR (%)
OUTSIDE DIMENSIONS: OVERALL LENGTH (IN.)
WIDTH (IN.)
HEIGHT (IN.)
ACCELERATION 0-60 M P H (SEC.)
40-60 (H)
50-70 (H)
TOP SPEED
MILES PER GALLON: 30 M P H
40
MI
60
SPEEDOMETER ERROR @ 60 M P H (%)
ODOMETER ERROR (%)

NOTES

All acceleration times and gas mileages are given in true m.p.h.
N.A.—Not announced (A) Includes federal excise tax but no



Testing equipment on all cars included a fuel meter to measure economy, and an accurate fifth-wheel speedometer. That's Automobile Editor Devon Francis behind Sprint's wheel. With just over 600 miles on the odometer, car was still stiff. A well-broken-in Sprint should do markedly better in fuel economy, acceleration, and top speed.

CORVAIR SPYDER	FALCON SPRINT	OLDS JETFIRE	TEMPEST LE MANS	STUDEBAKER SUPER LARK
MONZA COUPE	2 DOOR HARDTOP	SPORTS COUPE	2 DOOR HARDTOP	2 DOOR SEDAN
\$2,931.35	\$2,624.60	\$3,500.82	\$2,660.80	\$3,146.90
6	V-8	V-8	V-8	V-8
1-BBL. (B)	2-BBL.	1-BBL. (B)	4-BBL.	4-BBL.
150 @ 4,400	164 @ 4,400	215 @ 4,600	280 @ 4,800	300 @ 5,000 (C)
210 @ 3,200-3,400	258 @ 2,200	300 @ 3,200	355 @ 3,200	N.A.
3.4375 X 2.6	3.8 X 2.87	3.5 X 2.8	3.72 X 3.75	3.56 X 3.62
145	260	215.5	326	289
8.0	8.7	10.25	10.25	8.5
16.8	17.7	13.4	11.7	10.5
3,066	2,790	2,821	2,400	2,679
1,329	1,340	1,317	1,889	1,619
P	R	P	P	P
14	14	16	20	18
4	4	4	4	5
4-SPD. MANUAL 3.65-2.35-1.44	4-SPD. MANUAL 2.73-2.04-1.51	4-SPD. MANUAL 2.54-1.92-1.51	3-SPD. MANUAL 2.94-1.68	4-SPD. MANUAL 2.54-1.92-1.51
3.55	3.25	3.36	3.90	3.54
23.5-4.6	27-4.64	25.8-5.2	23.6-5.25	28.24-28 (E)-4.7
197.7	251.3	224	197.9	377 (G)
SINTERED METALLIC (F)	MOLDED ASBESTOS	MOLDED ASBESTOS	MOLDED ASBESTOS	MOLDED ASBESTOS
6.50 X 13	7.00 X 13	6.50 X 13	6.00 X 15	6.70 X 15
108	109.5	112	112	109
54.5-54.5	55-54.5	56-56	57.3-58	57.3-56.5
6	6.3	5.79	6	5.8
2,527	2,910	2,884	3,264	3,140
35-65	57-43	55-45	54-46	58-42
180	181.1	192.2	194.3	184
67	70.6	73.7	74.2	71.2
51.5	53.2	52.3	54.2	55.7
13.1	11	9.1	8.1	8.4
7.0	6.8	5.3	4.0	5.1
8.6	8.1	6.5	4.7	5.1
113	105	115	115	132
30.9	22.5	29.2	22.6	15.7
30.1	22.1	25.8	21.4	13.9
27.4	20.4	21.9	16.7	12.7
24.9	17.1	19.3	14.3	12
+ 5	+ 2.5	4.2	3.6	+ 2.8
+ 4.1	0	+ 1	+ 1	+ 4

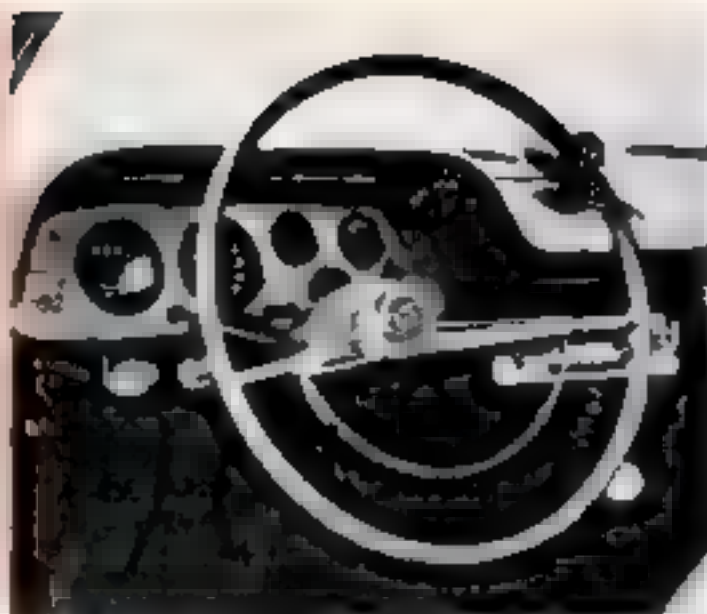
state or local taxes or dealer preparation charges. (B) Special design, not compatible with conventional carburetor. (C) Estimated; actual not announced. (D) First three gears (first two

for Tempest), high gear 1:1. (E) Variable ratio, high in center, slower as locks are approached. (F) Optional equipment. (G) Disks in front. (H) Timing includes downshifts.

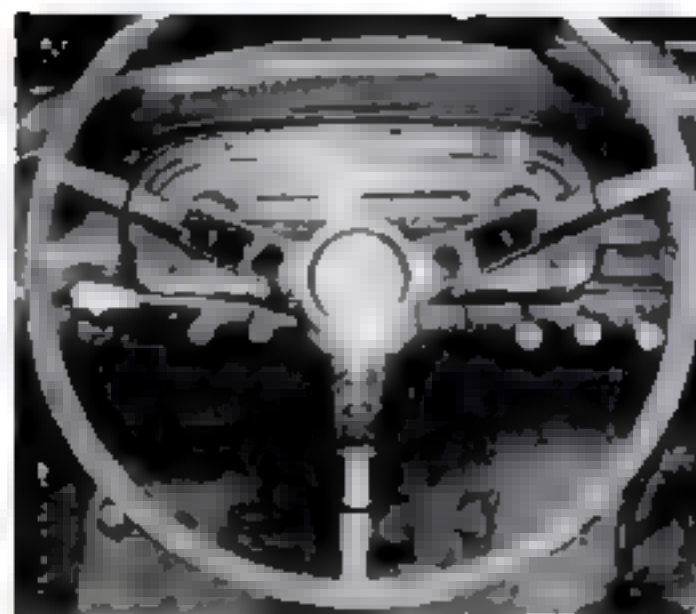
Fifth wheel is lowered for Tempest test runs by Alex Markovich as Pontiac engineer Dean Bedford Jr. points out the release bolt. Wet, slippery roads proved damaging to the Tempest's acceleration figures because of the tremendous torque its V-8 develops. Despite some feather-footing of the accelerator, rear-wheel spin remained a problem.



Legible gauges are important on high-performance cars. The Lark's dashboard layout is the best. It has a full array of instruments, no idiot lights. Gauges are round, and white-on-black graduations are easy to read. Two of the five cars—Sprint and Jetfire—have hard-to-read horizontal speedometers.

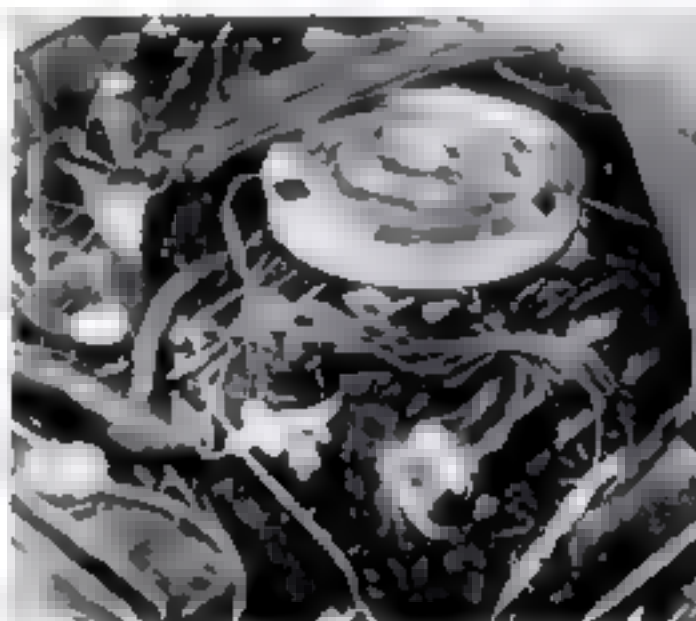
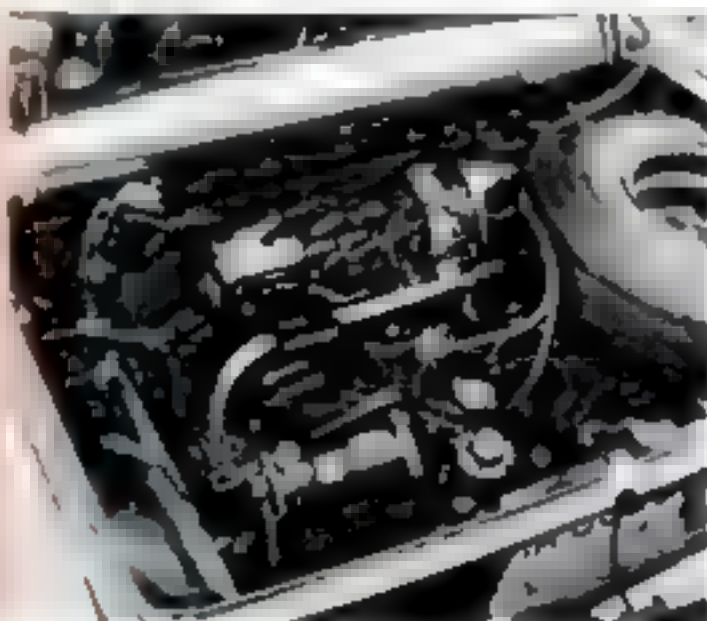


LYDIA



SPRINT

Crowded engine compartment is penalty paid for extra horses. The three blower installations resemble beds of snakes. The Falcon V-8 is crammed in where a modest six normally lives, and the Tempest V-8—big enough for a standard sedan—occupies a spot designed for a small aluminum V-8 or in-line four.



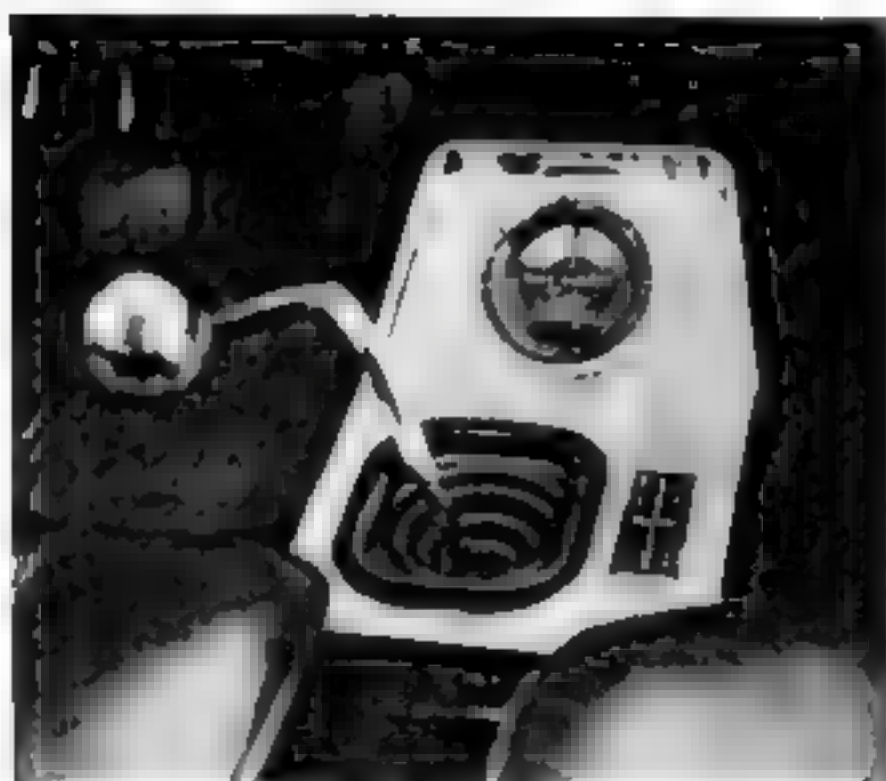
tially unchanged in power. While Buick's Skylark on the Special chassis boasts 200 hp., it has not been publicized as a performance compact. The Comet Sportster (with V-8) substantially duplicates the Falcon.

The five cars chosen, the truly hot compacts, bear fresh designations to

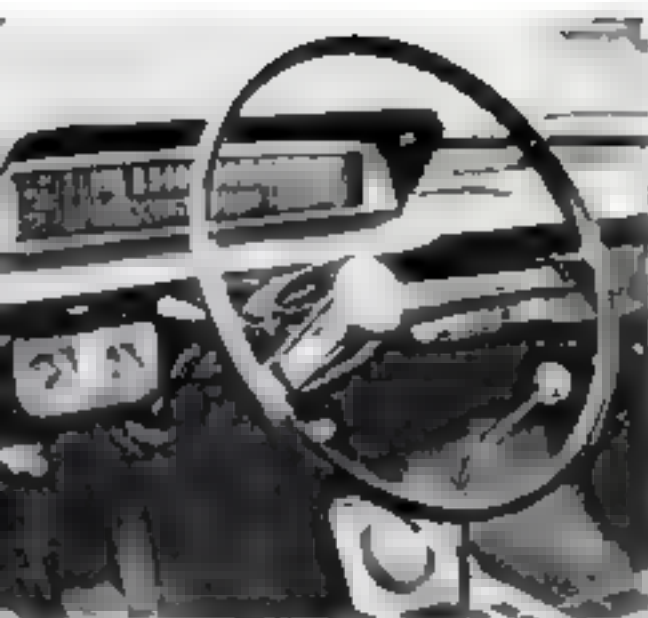
distinguish their muscularity from that of their forebears. The Spyder is the Corvair; the Sprint, the Falcon; the Jetfire, the F-85; the Le Mans, the Tempest, the Super Lark, the Lark.

As a reminder, the basic horsepower of these automobiles at their introduction were: Corvair, 80; Falcon, 85; F-85, 155; Tempest, 110; Lark, 90. For the Corvair, Falcon, and F-85, these horsepower are still offered. The lowest horsepower for the Tempest is now 115; that for the Lark, 112.

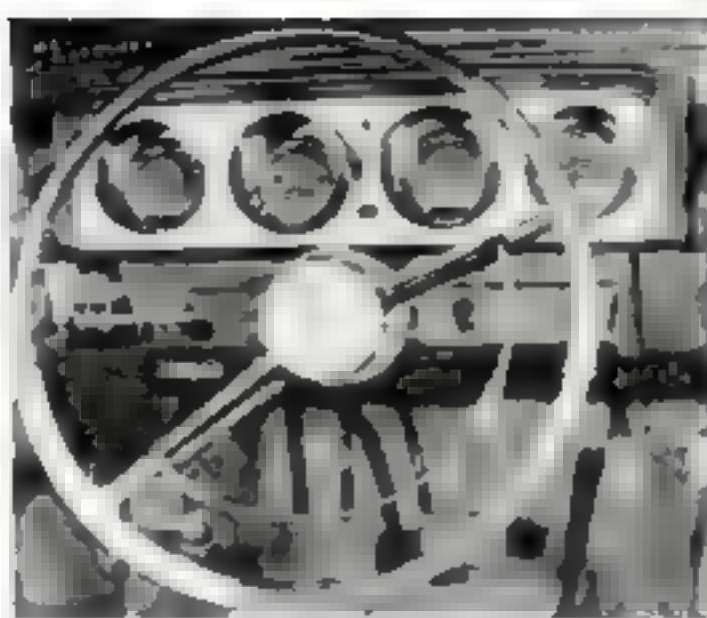
In engine design, the five hot compacts offer considerable contrast. Two schools of thought rule the automobile industry's engine engineers' doodlings. One believes that the easiest path to power is the big, "freely aspirated" engine, with cylinders opened up to great draughts of air and fuel from the carburetors. The adoption by the industry of the four-barrel carburetor—in some instances two four-barrel carbs or three two-barrels—is an example. The other school of thought runs to superchargers and turbochargers, cramming compressed



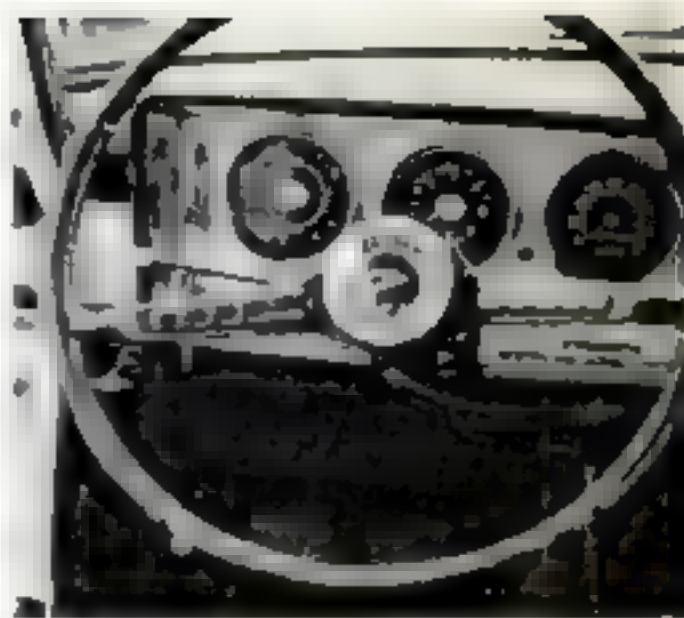
A vacuum gauge for horsepower can be mighty useful, but not as it's marked in the Jetfire. There are no graduations—just two markings, one for "economy," one for "power."



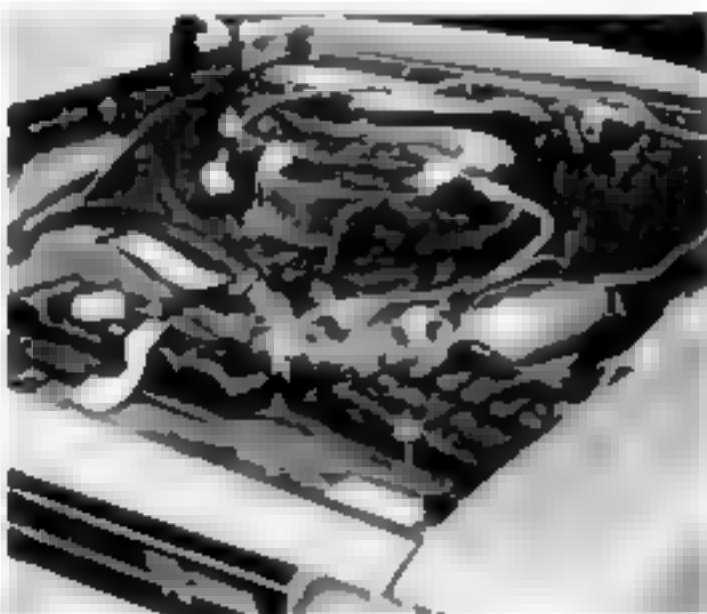
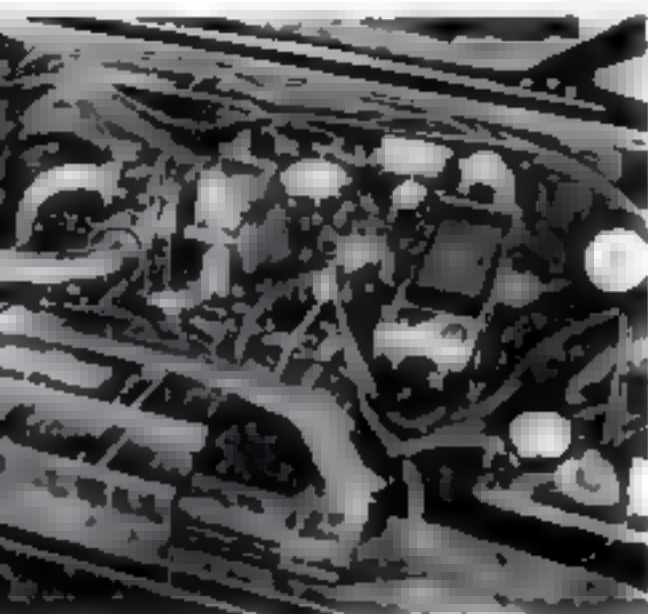
JETFIRE



TEMPEST



SUPER LARK



air and gas into the cylinders of a relatively small engine.

Today's hot compacts include two with freely aspirated engines: the Falcon Sprint and Tempest Le Mans. One, the Super Lark, is mechanically supercharged; and two, the Corvair Spyder and Olds Jetfire, get compressed air and fuel through blowers driven by turbines in the exhaust stream. The Sprint is limited to two barrels as a fuel-economy measure.

One engine in the five, that of the Spyder, is a flat six. The others are V-8s.

The axle ratios in the five cars tested were, in general, low (numerically high)—they were not geared for gas economy and top speed. Their goal: acceleration.

All the cars were the latest thing in automotive high fashion. They were gaudily trimmed, bucket-seated, and fitted—except for the Tempest—with fully synchronized manual four-speed transmissions. The Tempest carried a three-speed manual synchronized in second and third.

Finally, POPULAR SCIENCE's tests on

the Tempest, Spyder and Super Lark were run on rain-slick pavements. This could account for any disparities between our results and those obtained from the Pure Oil tests [see "Keep-'Em-Honest Car Test," April].

Here are the reports, car by car:

Corvair Spyder

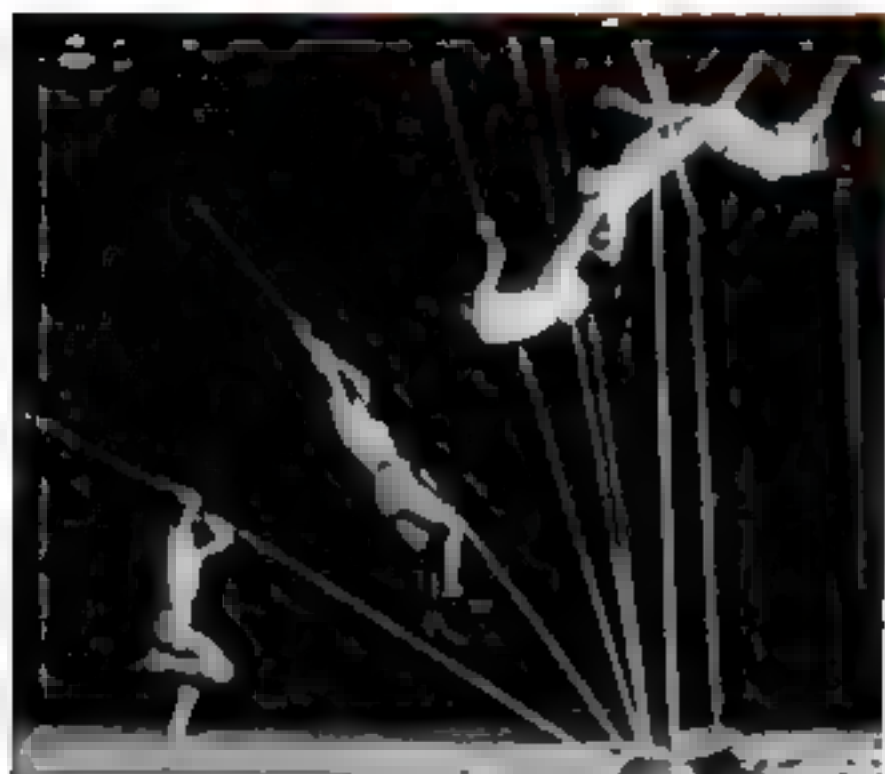
Though what makes the Spyder the Spyder is a turbocharger, a \$10.80 option on our test car stole the show. This is the factory-installed heavy-duty suspension, consisting of stiffer springs and shocks (and built-in negative camber on the rear wheels). The result: greatly improved cornering.

At low speeds, Corvairs (with either standard or heavy-duty springing) are understeerers—they require more than normal wheel turning to get around a corner. This is the result, despite a tail-heavy weight distribution, of specially designed suspension geometry and an unusually wide spread between front and rear tire pressures.

[Continued on page 188]

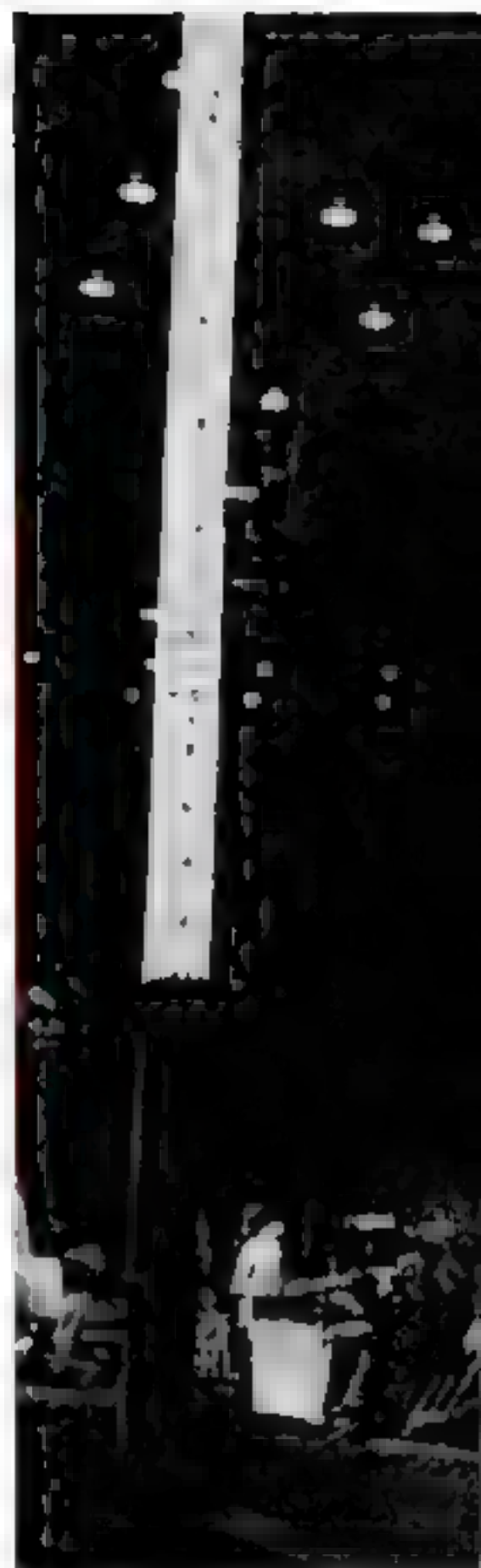
Why Sports Records Are Being Broken:

SCIENCE OR SUPERMEN?



Why pole vaulters are soaring 16 feet

Fantastic flexibility of new fiber-glass pole is shown at right as Marine Lt. Dave Tork "rides" it just before being "whipped" over the barrier at a recent Los Angeles meet. The multi-exposure photo at left of a vaulter in action shows rigidity of a metal pole, with bend almost imperceptible.



Today's athletes are running faster, jumping higher

By Robert Gannon

IT WAS called the Magic Number, and they had talked about it for a century. Eighteen years ago, Sweden's Gunder Haegg almost hit it—the four-minute mile—but missed by just under two seconds. Then in 1954, Roger Bannister of Great Britain broke the four-minute barrier.

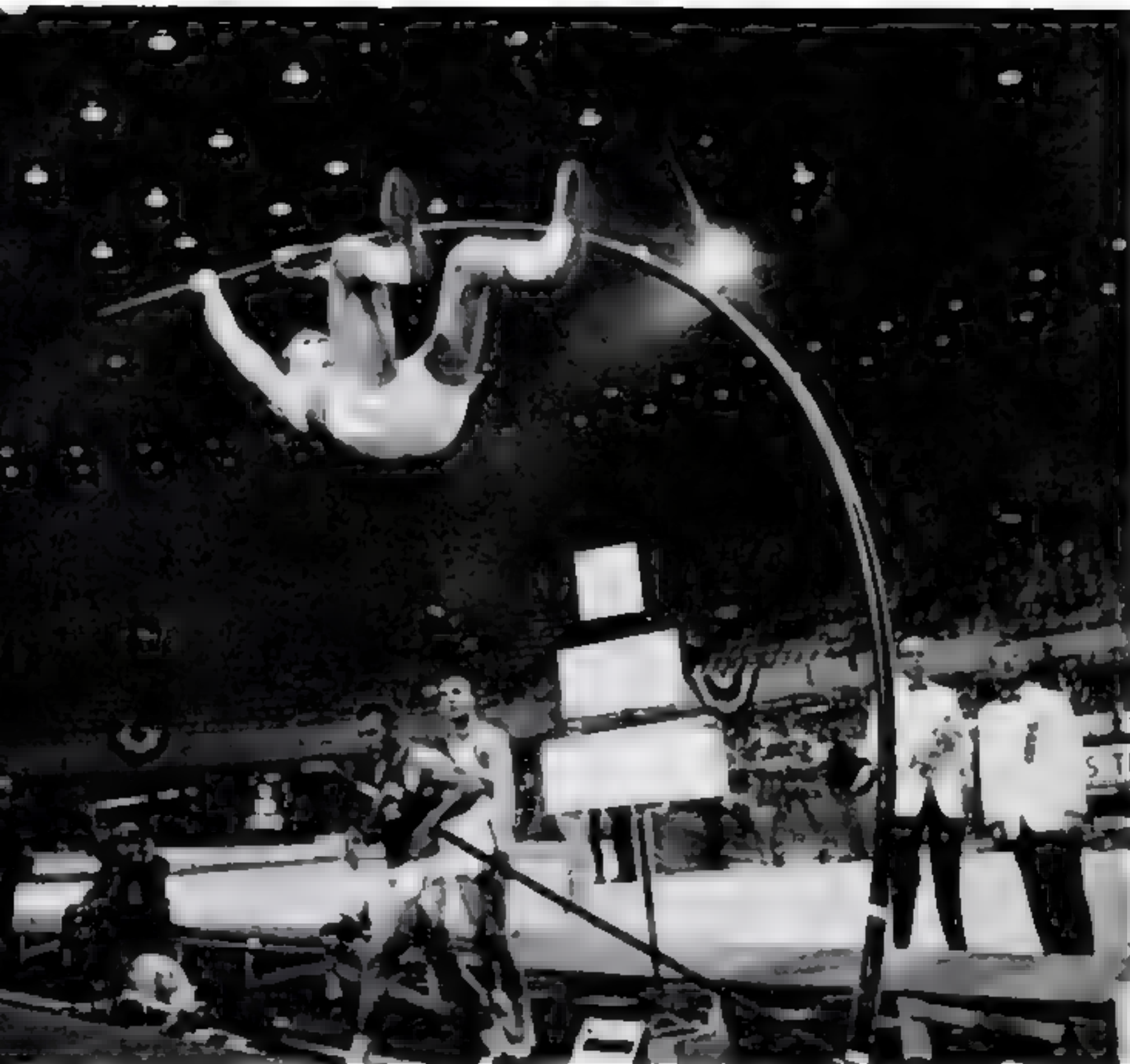
Once cracked, a less-than-four-minute mile became almost commonplace. Last August, on a notoriously slow track (London's White City Stadium), five men sped a mile in less than four minutes in

a single race.* By 1963, the barrier had been punctured outdoors at least 89 times by 35 men from 14 nations.

Other once-insurmountable sports records are crumbling like sand castles. Today's athletes jump higher, swim faster, throw farther, and score more points than ever before. Not a single men's Olympic or world track-and-field record is more than a dozen years old. Many more will fall before the year ends.

The reasons, say athletes, sports writ-

*The milers: Jim Beatty and U.S. teammate Jim Grelle, both at 3:56.5; England's Stanley Taylor and America's Bob Seaman, both at 3:58; and England's Michael Berisford at 3:59.2.



and broader, throwing farther. Here are some of the reasons

ers, and coaches, seem to number five more competitors, bigger participants, better training, finer techniques, better equipment

More competitors

This is probably the biggest single factor in current record crumbling. More of us are around today with more time to play. Children learn sports earlier (Arnold Palmer, three-time Masters champion, took to the golf course at the unlikely age of four); many schools have better physical-education programs, potential champs are spotted earlier, given

more training when they're younger.

And champs are keeping at it longer. Shot-putter Parry O'Brien says, "It used to be only in isolated cases that a track-and-field athlete continued to compete after 30, but now there are whole handfuls of them." O'Brien, now 31, is still competing more than 10 years after winning his first Olympic Gold Medal

Bigger participants

We perform bigger feats because we are growing larger all the time. Americans today are about an inch taller than their fathers and 12 pounds heavier

Bigger men, better equipment and training, add up to new



Breaking his own 1961 record by half an inch, Russian high-jumper Valery Brumel clears the high bar at 7 feet, 4 inches in this year's meet of the N. Y. Athletic Club in Madison Square Garden. Unlike vaulters, jumpers have to "do it yourself." Russian coach Gabriel Korbke says, "We are interested in developing men, not implements."

mainly because of better nutrition and reduction of childhood disease.

Taller men mean longer legs. Runners can reach farther back, can span longer distances without tiring.

Heavier men mean thick arms and wide hands, which swing golf clubs harder and more accurately. Bobby Jones, legendary golfer of the 1920s, drove 240 yards, in his prime. But wide-handed, beef-shouldered Jack Nicklaus, present U.S. Open champ, commonly drives the ball 260 yards, sometimes tops 325.

Long bodies mean that basketball players can spring up head-level with the basket, prime reason for today's sky-high scores. Wilt Chamberlain, the 7-foot, 1-inch San Francisco Warrior, averages 42 points a night, has made 100 in a single game. His father's height: 5 feet, 8 inches.

You don't *have* to be big to be a champ, of course. But if you aren't you'll probably have to work that much harder—which leads to the third big reason for record breaking:

Better (and more intensive) training

Jim Beatty stands only 5½ feet, weighs but 128 pounds. Yet he's the fastest American miler ever. One reason is that he runs about 100 miles a week. He

works until his body pains. "Have you ever had to run so hard up a long flight of stairs," he asks, "that your thighs begin to hurt?"

Or look at 19-year-old Bruce Kidd, named Canada's outstanding athlete for 1962. He runs up to 20 miles a day, often competes in two or three events in a single meet. "And if he can stay with it," says Daniel J. Ferris, secretary emeritus of The Amateur Athletic Union, "he'll undoubtedly become the greatest distance man in history."

Hard work and good coaching will continue to turn out good runners. According to William J. Bowerman, head track coach at the University of Oregon, "The ability to run a mile under four minutes is possessed by thousands of Americans. . . . Any man who can run a half-mile in 2:30 is a prospect." But he has to be trained—hard.

To temper the hard work and incessant training, most coaches advocate short periods of repose, alternating with periods of tremendous physical strain. Carried to the limit, this idea distills to an exercise method called *isometric contraction* (IC), newly rediscovered by coaches and participants of all sports—football (the '49ers use it), baseball (the Pittsburgh Pirates), high jumping (Bob Avant), or weight lifting (Louis Riecke).

sports records

Beating the four-minute mile in the U.S.: The three runners in front at right all made it. This barrier, first broken by England's great Roger Bannister in 1954, has now been pierced at least 89 times by runners from 14 countries. Jim Beatty, winner here at 3:57.9, has bettered this time by setting a record of 3:56.5 in England.



IC simply is pushing against buildings, squeezing stones, lifting trucks. The object is to strain for a few seconds against an immovable object—the opposite to calisthenics, or *isotonic* contraction, where muscles do real work.

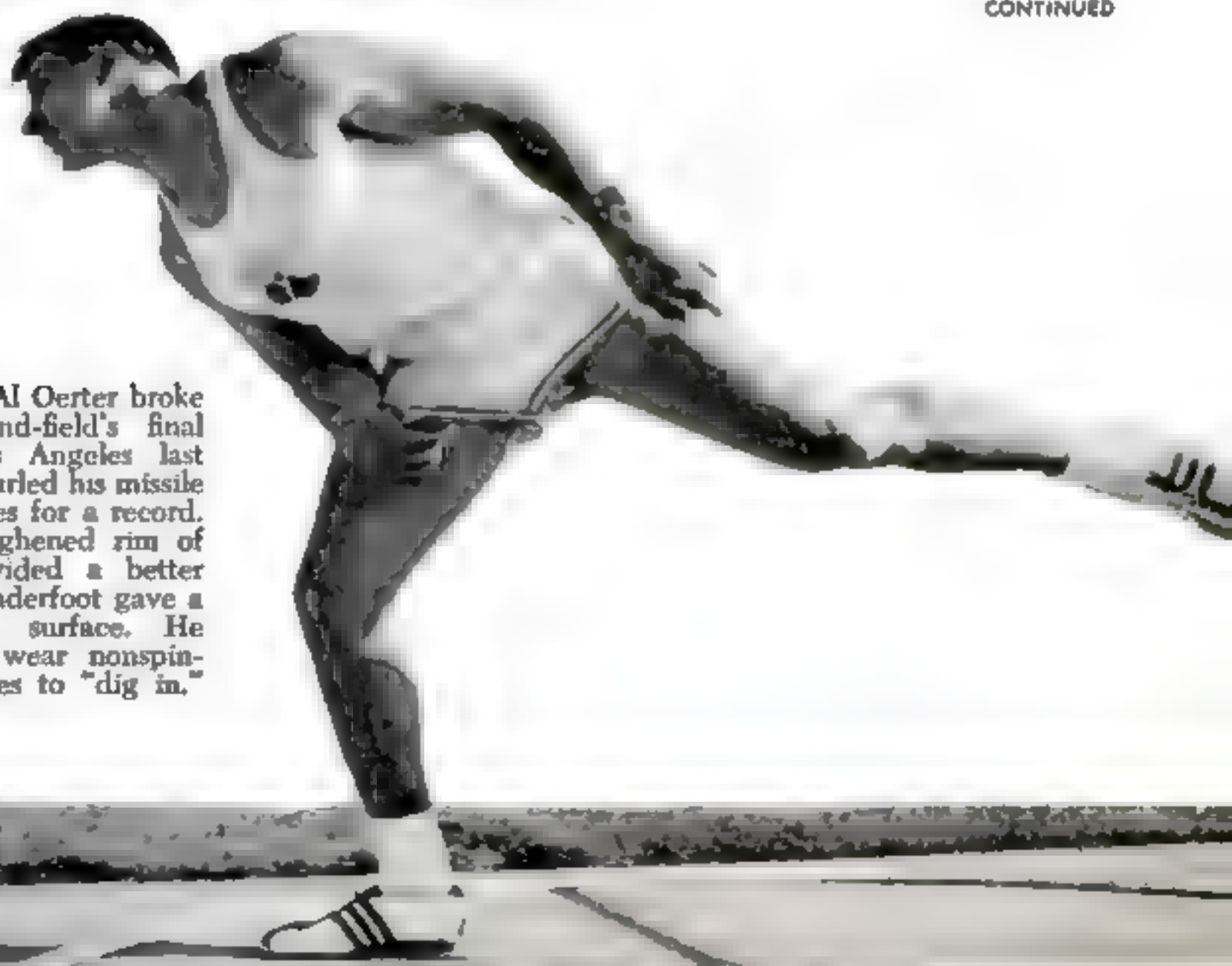
Key to exercise without movement is a single intense strain rather than a series of light contractions. Experts recommend a major pull or push for about 10 seconds, say that the average man can increase his lifting power 100 per-

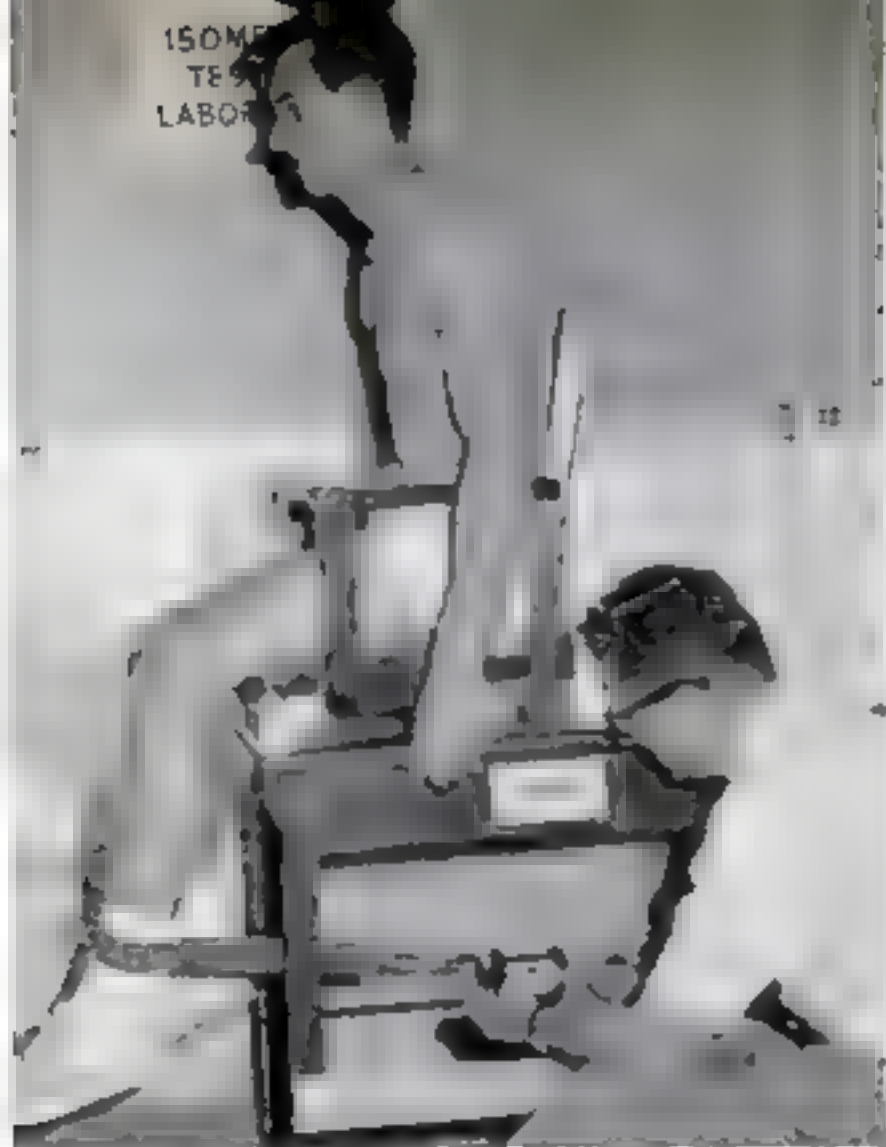
cent in a 20-week period, contracting hard just once a day.

One booster is Bob Hoffman, Olympic weight-lifting coach and publisher of *Strength and Health* magazine. Says he: "I'm absolutely awestruck at the miracles it has wrought." So sure is he of the effectiveness of IC that he has designed and is selling a stationary bar that can be set at various heights to help in a workout. Can't damage furniture that way.

CONTINUED

Discus thrower Al Oerter broke one of track-and-field's final barriers in Los Angeles last June when he hurled his missile 202 feet, 2 inches for a record. His secret: Roughened rim of the discus provided a better grip; concrete underfoot gave a better whirling surface. He didn't have to wear nonspinning spiked shoes to "dig in."





Isometric muscle-contraction exercises condition takeoff leg of Fairleigh Dickinson high jumper, Ray Bury. After seven weeks of IC training, his jump height increased 3½ inches.

"I once pulled a washbasin out of the wall," claims Hoffman.

The exercise does develop muscles, but as Dr. Arthur H. Steinhaus of Chicago's George Williams College points out, "It does nothing for the heart or lungs; it does not increase endurance . . . only strength."

Finer techniques

This is the fourth major reason for today's crumbling records. A slight change of style can often shave important seconds, stretch vital inches, add a point or two.

When hurdlers learned that they travel faster on the ground than in the air, they practiced stepping over the barriers straight-legged, snapping the trailing leg over fast and touching the ground as quickly as possible. Result: broken records.

In swimming, more than 100 men today can beat Johnny Weismuller's 100-yard record of 51 seconds. They're using fast flip turns he never thought of.

And today's major-league pitchers have completely eliminated the .400 hitter, and have even about squelched the .350

man. Reason, according to Stan Musial: "Every pitcher you face has the slider" (a fast ball that breaks a few inches lower on the bat, near the handle). "Very few pitchers had it when I came up to the majors."

High jumpers used to use the "scissors" technique almost exclusively, clearing the bar in a seated position. But they found that by going over flat on their bellies in a western roll, the center of gravity lowered significantly, making it that much easier. Now something new may be coming. Bob Avant, an unorthodox springer, leaps head first and clears seven feet with ease. Before Avant, almost nobody believed it could be done that way. Now others are eyeing the technique.

In broad jumping, the secret used to be top speed and top height, with the legs out straight; distance would take care of itself. But Ralph Boston, a little-known Tennessee State University jumper, didn't agree. After he solidified the technique of what he calls walking in the air—"I take 3½ steps before I land"—he easily bettered Jesse Owens' 25-year-old world record (26 feet, 8½ inches) by a half-foot.

Few field events can match the pole vault for change. In 1937, Sabin Carr made a sensational leap: 14 feet. Afterward, he blithely stated that no one would vault higher. Yet a few years later an unorthodox upstart named George Varoff took a longer run, used a higher grip, and sailed over the 14-foot, 6½-inch mark. With his new technique widely publicized, Varoff's mark lasted only a few weeks. At the 1949 Chicago Relays, 9 men vaulted 14 feet in less than 10 minutes, and last year more than 40 men scaled 15 feet, half a dozen topping 16. By the time you read this, someone may very well have soared over 17 feet.

Ask a first-class pole vaulter exactly how he operates, and he'll give you a detailed report on where his limbs are during each phase of the vault. But he may be wrong. Dr. R. V. Ganslen, UCLA kinesiologist and the world's foremost

[Continued on page 196]



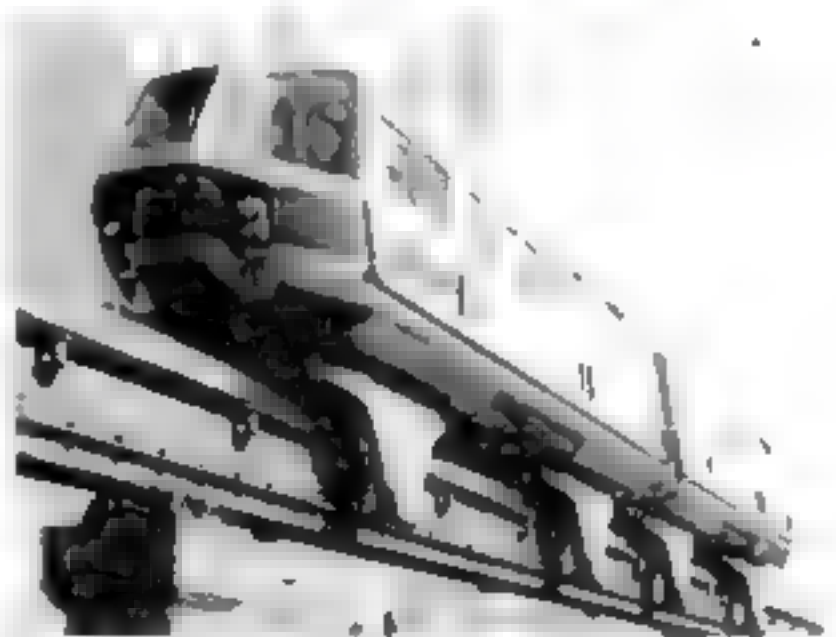
Monorail switch is hinged section of track mounted on trundle that mates it with main track.

U.S.-designed monorail opened near Tokyo

A four-mile experimental monorail has been put into operation from Nikko, north of Tokyo, to Kirifuro Falls, a picnickers' goal, in an effort to solve Japan's need for mass transportation using minimum ground space.

The system, designed in the U.S., employs lightweight air-sprung cars riding on rubber-tired steel wheels on a track supported by prestressed concrete pillars. Horizontal wheels along the sides prevent sway.

Lockheed Aircraft helped organize the company with a half-dozen Japanese firms.



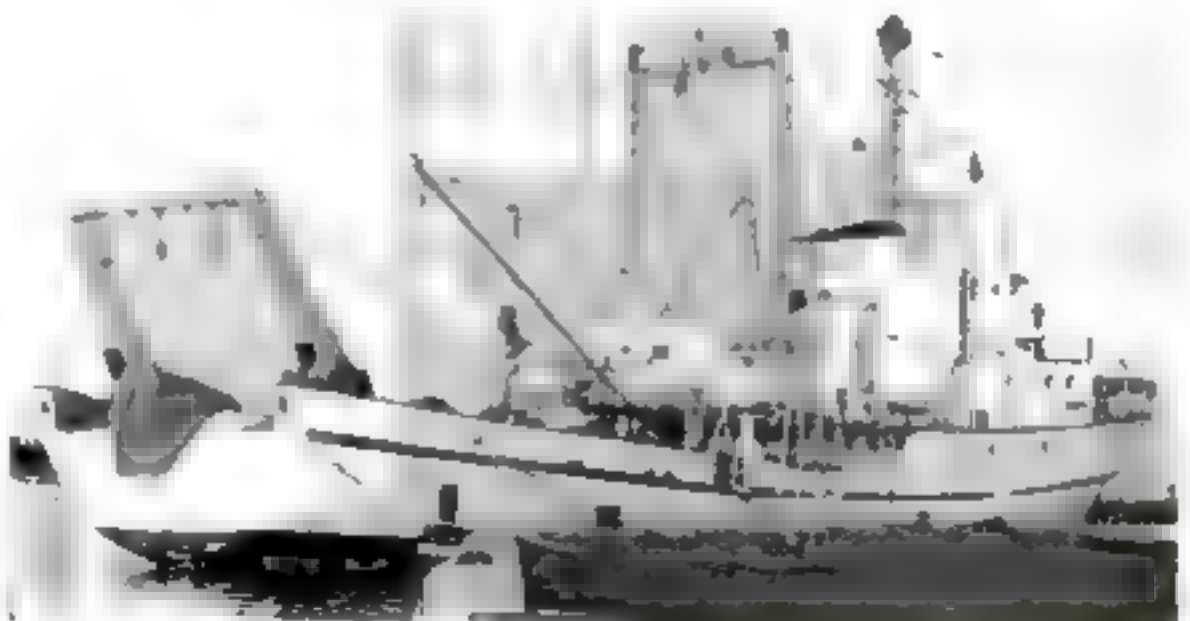
Tandem pairs of drive wheels support cars front and rear on trucks straddling rail.

Fish-research ship is floating laboratory

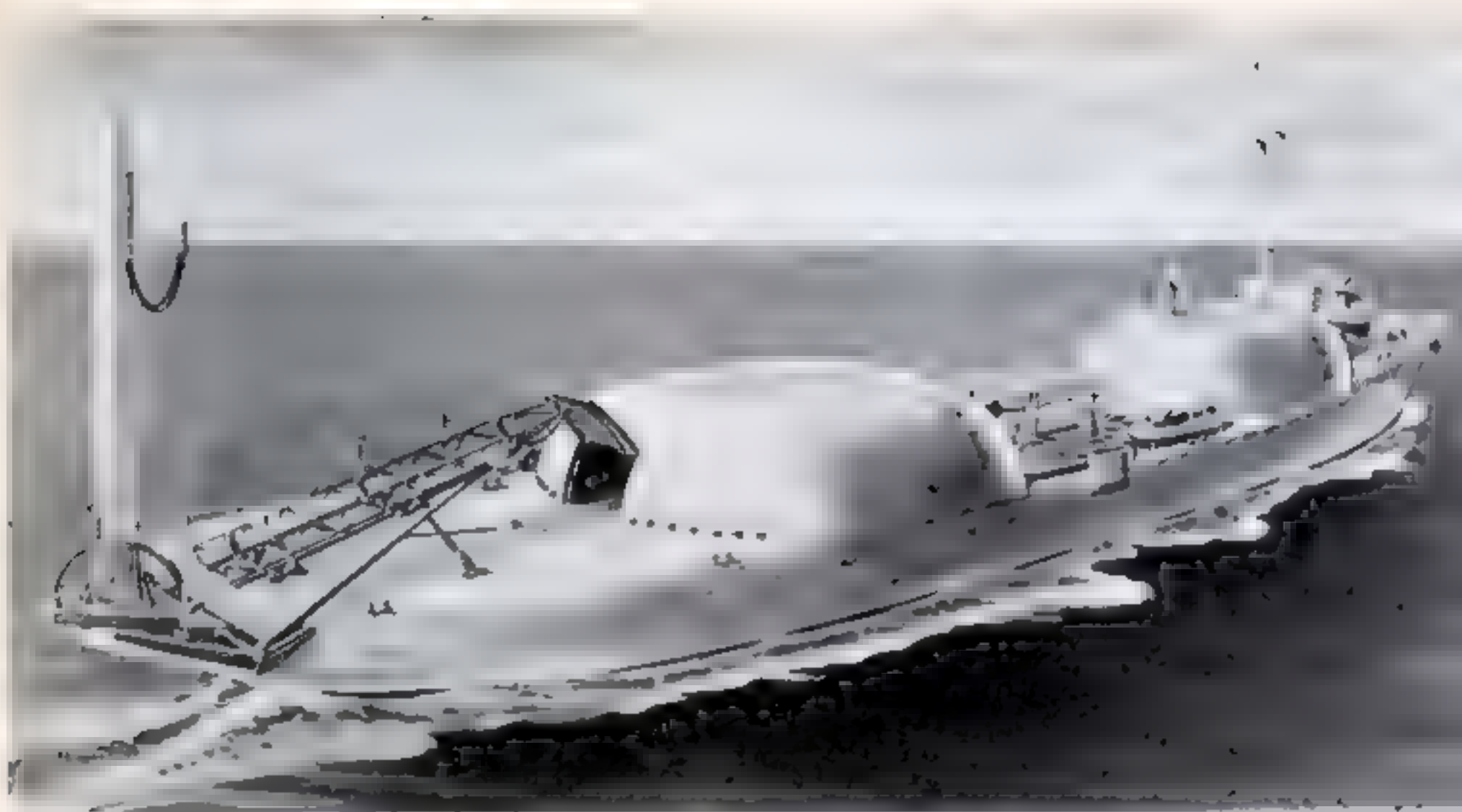
Latest ship to put out of the oceanographic institute at Woods Hole, Mass., is the Albatross IV at right. It's a marine biologist's dream.

Packed with electronic and other gear, it can stay at sea six or seven months at a time to study ocean life.

The ship cost the U.S. Bureau of Commercial Fisheries \$2,000,000 to build. Among new features: a powerful stern gantry that will lift 10,000 pounds of specimens from



the sea, TV cameras to scan operations, and fully equipped labs above and below deck.



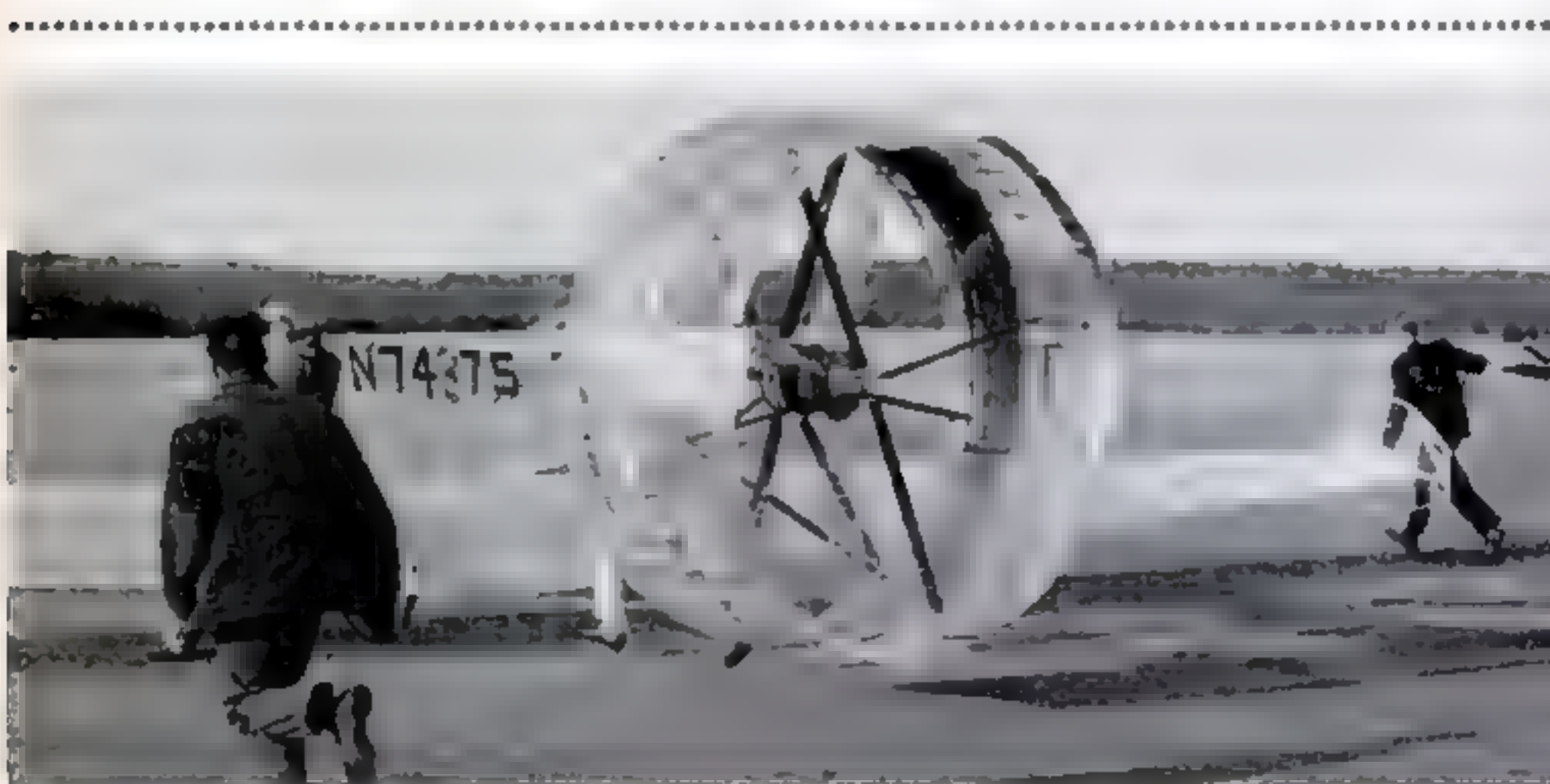
Navy Designs Seagoing Pad to Launch Satellites at Sea

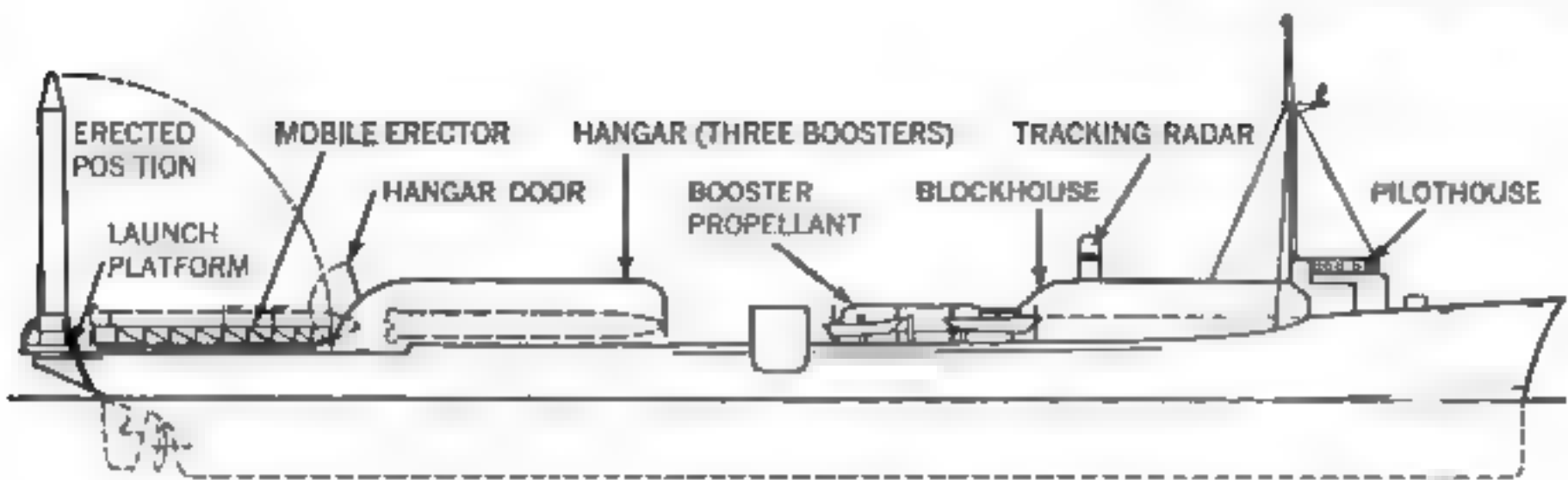
Resembling some futuristic battle wagon, the naval craft pictured here would actually have a peaceful mission. It's a proposed satellite-launching vessel, designed by the U. S. Navy's Bureau of Ships during a recent study of the feasibility of launching space vehicles at sea.

What the Navy envisions is a 17,700-ton

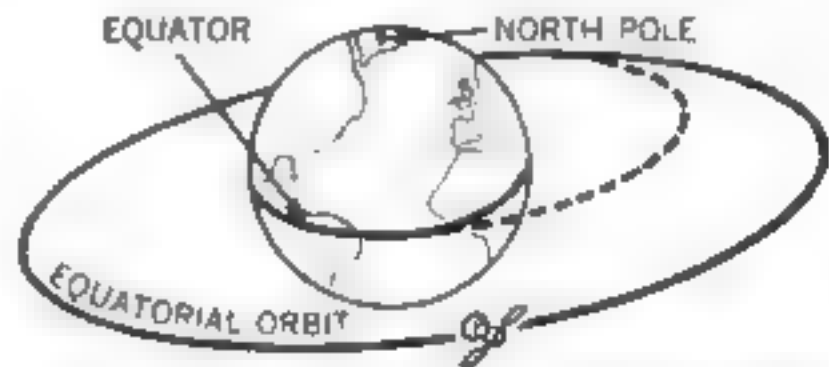
ship with an overall length of 565 feet and a 78-foot beam. It would cruise 10,000 miles at 20 knots.

Bulging above deck, a hangar aft houses up to three satellite-launching rockets. One at a time, they are erected and fired from a launcher hanging out over the stern. Another bulge, forward, serves as a block-





Proposed satellite-launching vessel (left) would have rocket hangar and launcher aft, blockhouse forward, shown in profile above. From position on equator, the ship could put a weather or communications satellite into the desirable equatorial orbit shown at right, which would enable a satellite of suitable velocity to hang motionless above the earth.



SATELLITE HANGS STATIONARY ABOVE EARTH

house during the countdown. Stabilizing tanks, and an oversize rudder linked to an autopilot, steady the ship enough for launchings while under way at 15 knots, in a sea with waves up to five feet.

Such a craft would have important advantages over present U.S. launching sites in Florida and California. Roaming the globe, it could put up a satellite from anywhere. In particular, it could launch one from the equator—the simplest way to place a satellite in a desirable "equatorial orbit" so as to hover over one spot on earth, as coming U.S. weather and com-

munications satellites are intended to do.

Launched from Cape Canaveral in Florida, say, a satellite could not remain truly stationary—but would swing back and forth across the equator in a figure-8 pattern [see "The Stay-Putnik," March, '63], unless its course were altered to an equatorial orbit after launching. That would take a powered, remote-controlled maneuver, difficult by present technology. One alternative would be to build a whole new U.S. launching complex, on land, somewhere along the equator. A satellite-launching ship, its proponents believe, offers a simpler answer.

Pedal-power plane wins master's degree for builder

The flying bicycle at left was conceived and built by James M. McAvoy, a 26-year-old student at Georgia Tech. The project was approved as his thesis for a master's degree in aerospace engineering.

The MPA-1—for muscle-powered aircraft—has a wingspan of 54 feet stretching out from a 16-foot fuselage, with a mylar skin covering an aluminum-and-balsa frame. Pedals transmit power through a gearbox and torque tubes turning counter-rotating propellers at 240 r.p.m.

McAvoy had the help of plans for a British man-power plane built last year and an Italian one that flew in 1937. Although his plane didn't get off the ground on first try, it's designed to take off at 17 m.p.h., reach 10-foot altitude at 20 m.p.h.

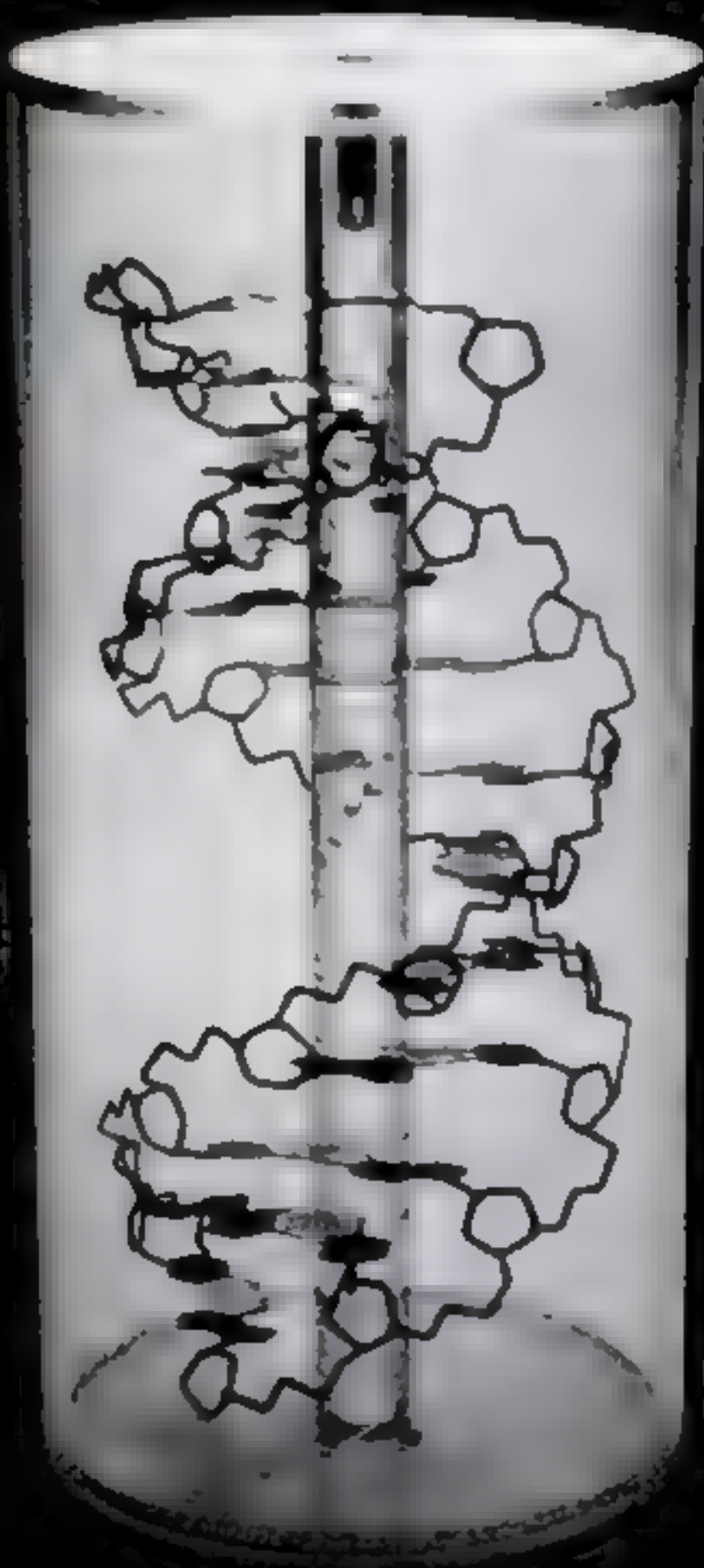
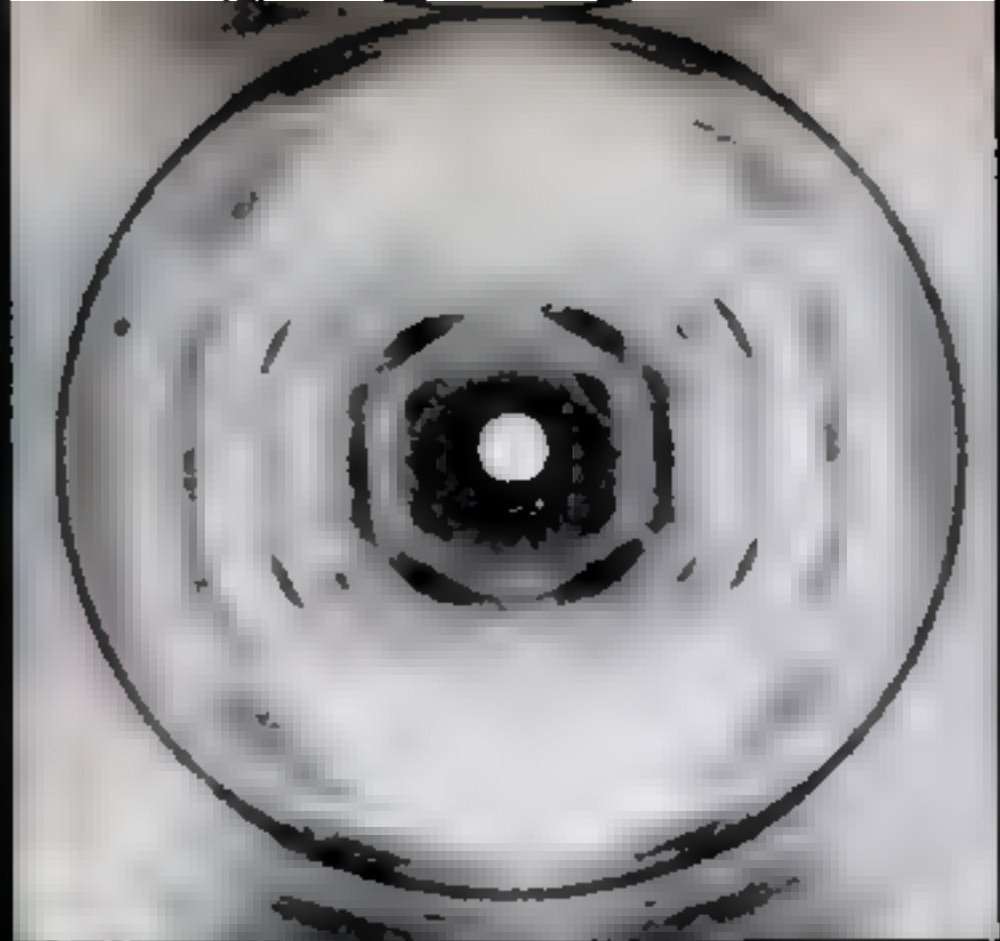


Drive is like a bicycle's with stick to operate controls. Pilot Robert W. Ritchie trained on a dynamometer.

DNA

It Calls the Signals for Life

Like a spiral staircase, shape of DNA molecule is shown by model at right, worked out mathematically from X-ray diffraction photos, like one at top by L. D. Hamilton of Sloan-Kettering Institute.



How three men got the Nobel Prize for solving a jigsaw puzzle: assembling the pieces of a molecule that made you what you are—and keeps you ticking

By Wallace Cloud

LAST December an American biologist and two English physicists received formal recognition, in the shape of a Nobel Prize, for a discovery made 10 years ago—a discovery that started a chain reaction in biology.

They determined the structure of a molecule that provides answers to questions scientists have been asking for over a century:

- How does a heart muscle "know" how to beat?
- How does a brain cell "know" how to play its role in thinking and feeling?
- How do the cells of the body "know" how to grow, to reproduce, to heal wounds, to fight off disease?
- How do infectious bacteria "know" what diseases to cause?
- How do single fertilized egg cells, from which most of nature's creatures begin, "know" how to become plants, animals, people?
- If one such cell is to multiply and form a human being, how does it "know" how to produce a potential Einstein or a Marilyn Monroe?

The stuff that genes are made of. Sounds like a lot to expect of a molecule—even one with a jaw-breaking name like deoxyribonucleic acid (known more familiarly as DNA). But it's scientific fact that DNA is what genes are made of. DNA molecules supply the basic instructions that direct the life processes of all living things (except a few viruses). The DNA molecule contains information in a chemical code—the code of life.

The effects of discovery of the structure of DNA have been called "a revolution far greater in its potential significance than the atomic or hydrogen bomb." Professor Arne Tiselius, President of the Nobel Foundation, has said that it "will lead to methods of tampering with life, of creating new diseases, of controlling minds, of influencing heredity—even, perhaps, in certain desired directions."

I asked the American member of the Nobel Prize trio, Dr. James D. Watson, about these speculations in his laboratory at Harvard. It was a few weeks before he flew to Stockholm to receive the award

Three Nobelmen



Dr. James D. Watson, now at Harvard, worked on DNA in 1953 while in England.



Dr. Francis H. C. Crick of Cambridge was Watson's partner in the research.



Dr. Maurice H. F. Wilkins, King's College, London, made essential X-ray photos.

CONTINUED

along with Dr. Francis H. C. Crick of Cambridge University and Dr. Maurice H. F. Wilkins of King's College, London.

The boyish 34-year-old Nobelman, who did the prize-winning research in England when he was only 25 (he entered college at 15, had been a Quiz Kid before that, in the days of radio), refused to endorse the wilder predictions about the future of DNA research. He said, "The average scientist busy with research looks ahead anywhere from an hour to two years, not more."

Conceding that discovery of the structure of DNA was as important as the working out of atomic structure that led to the atom bomb, he added, "It will have a very profound effect, slowly, on medicine. Doctors will stop doing silly things. Our knowledge of DNA won't cure disease, but it gives you a new approach—tells you how to look at a disease."

Dr. Watson went on to explain just what he and his co-workers discovered during those days of inspired brainwork in England, back in 1953, and how they did it.

The discovery was not the work of an institute-full of technicians, he said, but the product of four minds: He and Crick did the theoretical work, interpreting cryptic X-ray diffraction photos made by Wilkins, who had as collaborator an English woman scientist, Dr. Rosalind Franklin. She died in 1958. She "should have shared" the Nobel Prize, said Dr. Watson.

Picking up the thread. DNA was not a newly discovered substance. It had been isolated in 1869, and by 1944 geneticists were sure it was the substance of the genes—the sites of hereditary information in the chromosomes. Then they started asking, "How does it work?" That's the question Watson and his co-Nobelists answered.

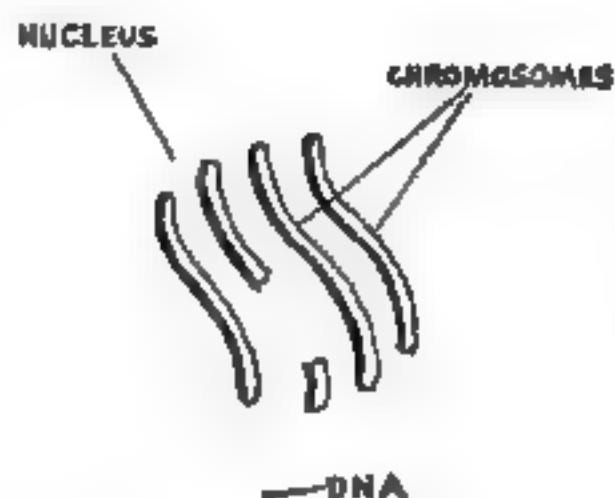
They knew DNA as one of the most complex of the "giant molecules" known to man. It was believed to have a long, chainlike structure consisting of repeating groups of atoms, with side groups sticking out at regular intervals.

The shape of the DNA molecule was important. In the cell, many of the larger molecules work together like machine parts, and their mechanical properties are as important as their chemical activity. However, even the electron microscope, through which it is possible to see some of the biggest giant molecules, shows DNA only as a thread, without detail.

One way of "looking" at molecules is to take them apart by chemical treatments that make

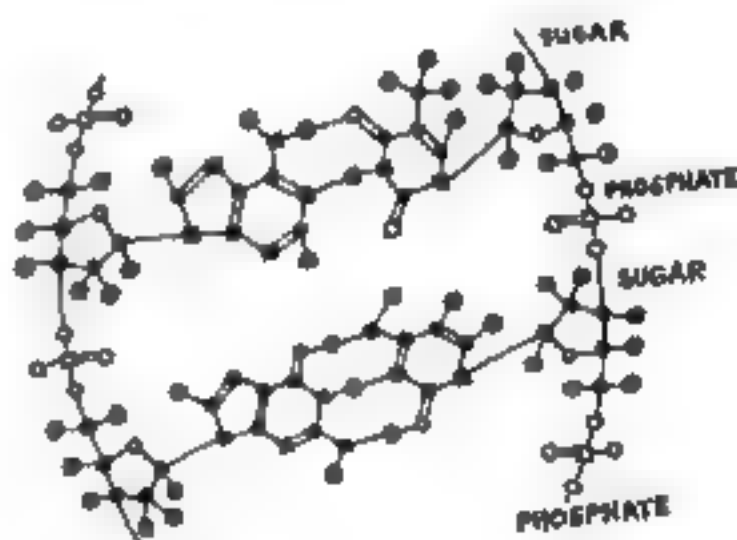
[Continued on page 186]

How DNA molecules



A miniature chemical factory, the living cell (diagrammed above) is controlled by "executive molecules" of DNA—deoxyribonucleic acid. In all plant and animal cells, DNA is located in chromosomes, threadlike bodies in the nucleus. Bacteria have simpler structures, but are also directed by DNA.

Control depends on the ability of DNA molecules to store and transmit information. Long, twisted strands of DNA are archives of instructions for



● CARBON
■ NITROGEN
○ OXYGEN
□ PHOSPHORUS
● HYDROGEN

all processes of the cell.

Information is recorded in a molecular code made possible by the structure of the DNA molecule, detailed above.

Twin backbones are repeating chains of submolecular units, called deoxyribose sug-

supply instructions to direct life processes of living things

ars, linked together by phosphate bonds. Bridging across are pairs of subunits named adenine, thymine, cytosine, and guanine—usually called A, T, C, and G.

These units serve as a four-letter alphabet. As shown below, their sequence spells "words" that are meaningful to the cell.

Instructions are read by means of another kind of molecule, RNA (ribonucleic acid), a single twisted chain with side groups that correspond to the subunits of DNA. RNA mole-



this rule is followed throughout illustration.) Thus, the strands are not identical, but are complementary, and each can serve as a template for the reconstruction of the other.

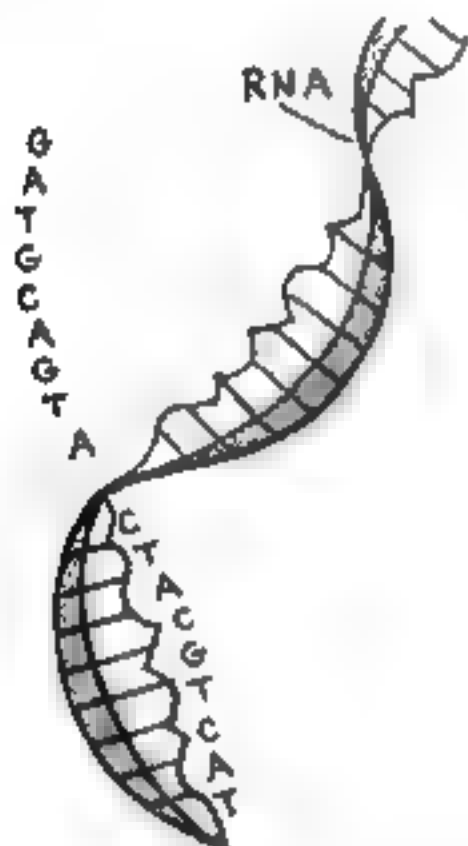
When a DNA molecule is to be copied, the molecule "un-zips," as shown symbolically above. Then the machinery of the cell uses the same zipper-like action to reconstruct each missing half, as shown below, from subunits freely available in the nucleus of the cell. Now there are two DNA molecules identical with the original one.

Every DNA molecule in the chromosomes of a cell is cop-

ied prior to cell division, the basis of all reproduction. When the cell divides, the chromosomes split in half and a full complement of half-chromosomes goes into each new cell.

Since all the information-bearing DNA molecules have doubled, each cell now contains exactly the same stored instructions as the original parent cell, and can carry out the same life processes.

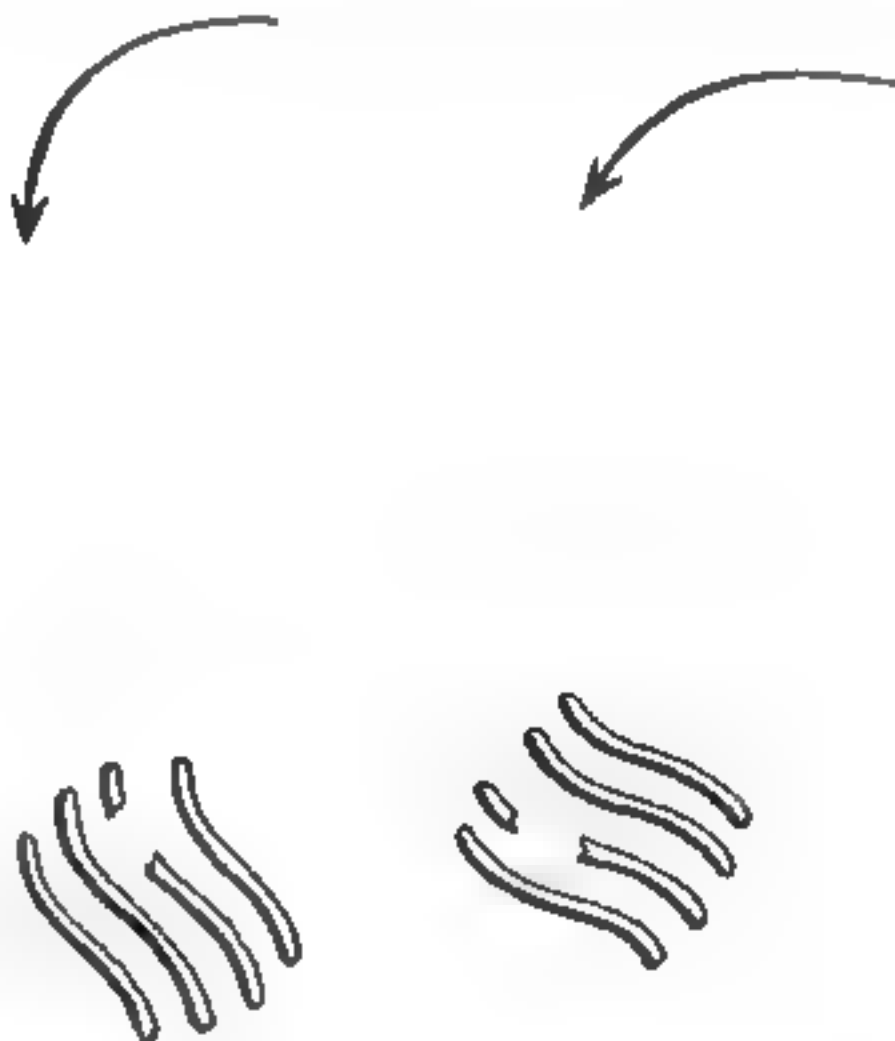
That's how you got those big brown eyes. (The family secret for manufacturing the pigment in your eyes was handed down by means of your ancestral DNA.)



cules are built by the chemical machinery of the cell, using one strand of a DNA molecule as a template. Then the RNA molecule peels off, acts as a messenger to deliver instructions elsewhere in the cell.

Two-stranded structure of DNA makes possible use of the same information-transfer mechanism for copying DNA molecules, so that hereditary instructions can be passed from generation to generation.

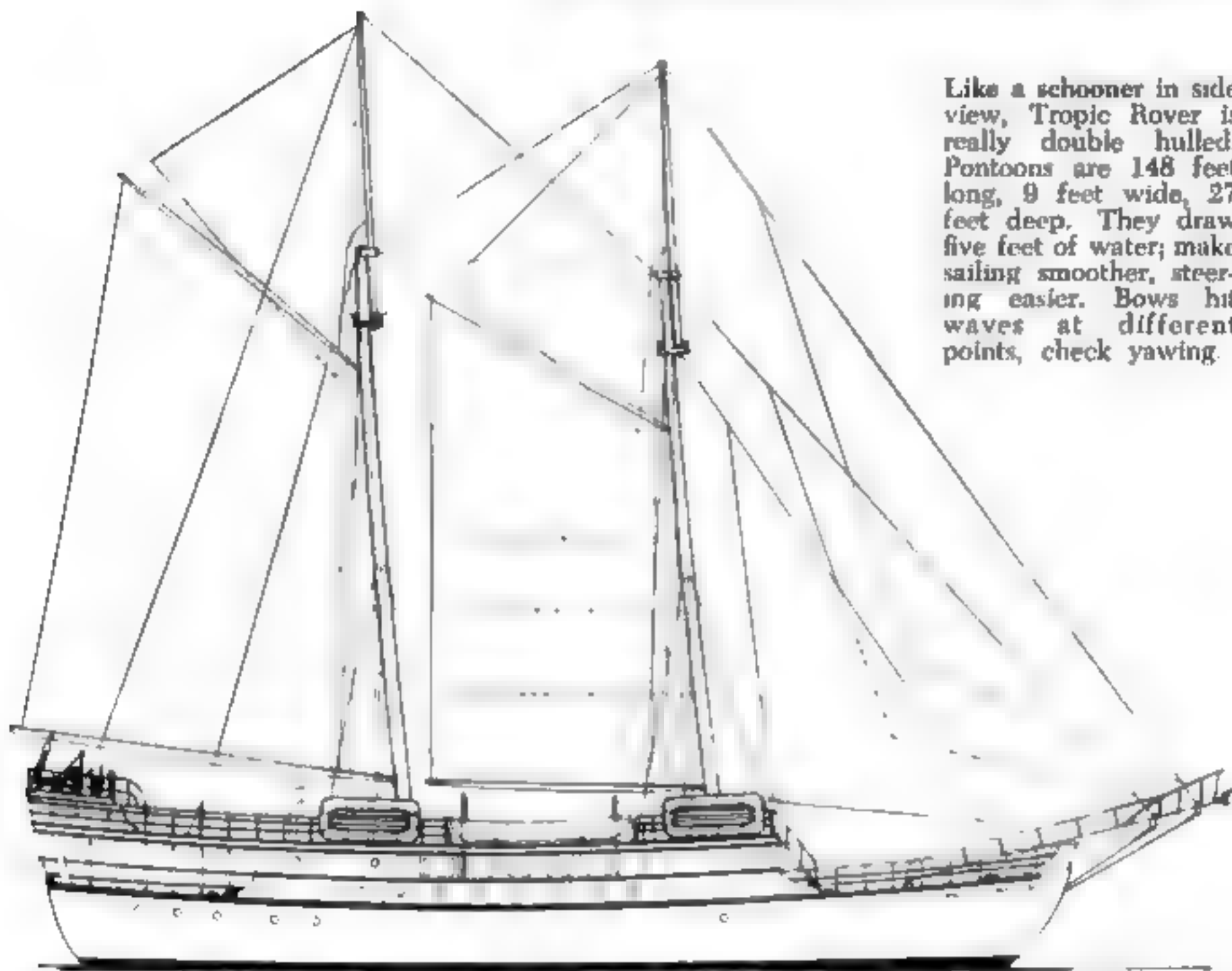
Pairing of subunits follows a rule: A can pair only with T, C pairs only with G. (Note that



Big cat island-hops in Bahamas

The \$400,000 Tropic Rover, world's largest catamaran, is now a familiar sight in the waters off the Bahamas. Built at Fort Lauderdale's Summerfield Boat Yard, the 150-ton fiber-glassed-plywood cat measures 175 feet from bowsprit to stern. Fully loaded, she draws only five feet of water, making it easy to slither in and out of shallow coves.

Capt. Sid Hartshorn, designer and skipper, makes Nassau her home port. The Rover takes on as many as 66 passengers for informal 10-day cruises through the islands, following the prevailing winds and



Like a schooner in side view, Tropic Rover is really double hulled. pontoons are 148 feet long, 9 feet wide, 27 feet deep. They draw five feet of water; make sailing smoother, steering easier. Bows hit waves at different points, check yawing.



Fishermen use bowsprit catwalk (left); swimmers, shore parties use ladder (foreground) to enter water or dinghies.



British flag flies from Nassau-based catamaran.

stopping at Governor's Harbour on Eleuthera Island, at Harbour Island, and several other places. Besides 10,000 square feet of sail billowing from masts 131 and 135 feet tall, the Tropic Rover has two 270-hp. auxiliary diesels. Either wind power or engine can push her up to 12 knots.

Passengers occupy staterooms in the twin 148-foot hulls, aft under the quarterdeck, and in fo'c'sle dormitories. Cocktail lounge and dining room are on the main deck, an underwater-viewing room in one of the hulls, and swimming between the two.



Rover's yardarms can carry 10,000 square feet of sail

PS PICTURE NEWS



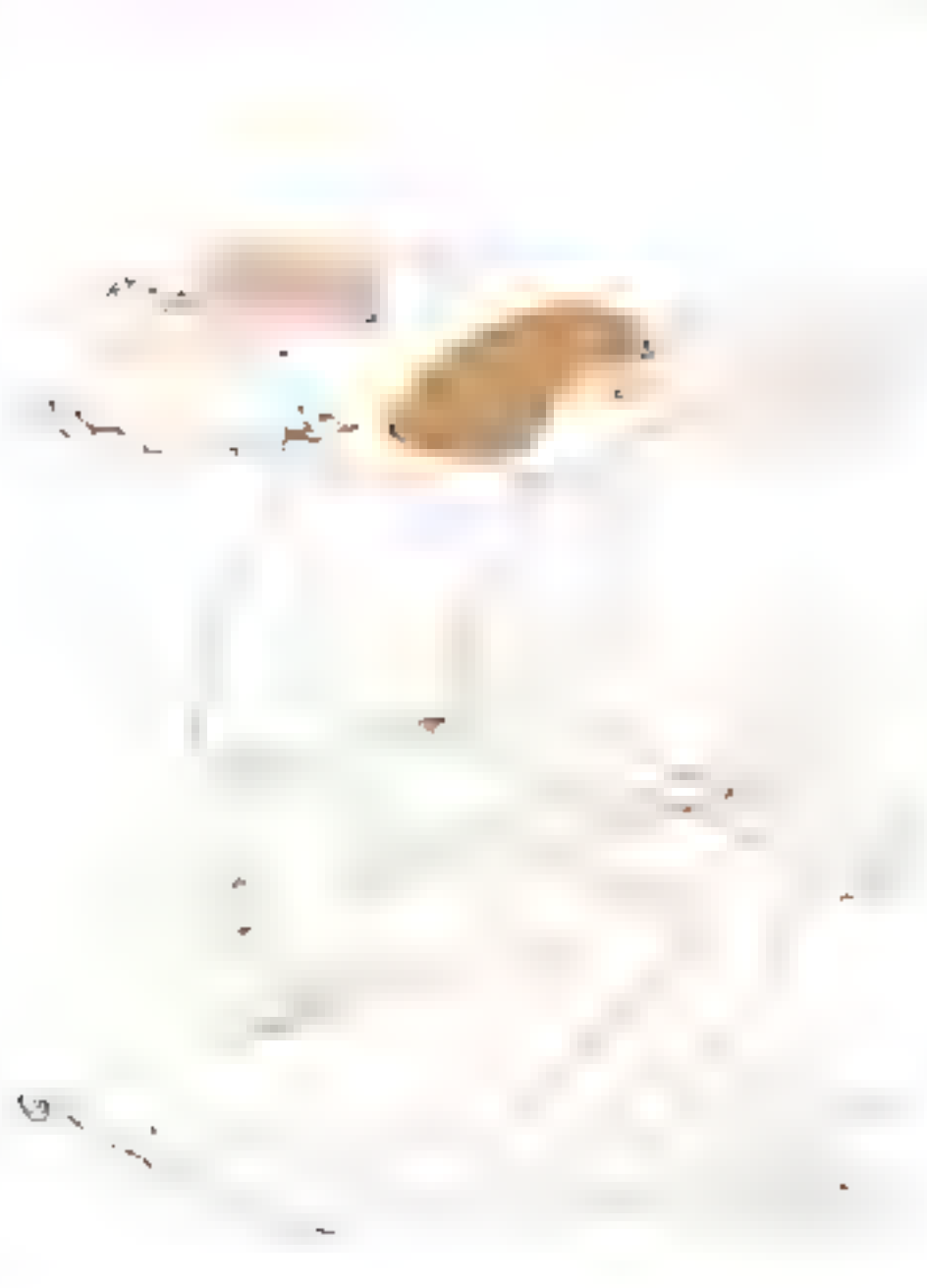
Scoots to pick up street litter

If this keeps up, the street-cleaning man's pushcart will soon give way to a motorized version. New York City's Department of Sanitation is trying out a three-wheeled litter-collecting vehicle as a possible replacement. If all goes well, the new Litter Scooter will help speed up the work of keeping city streets, parks, and playgrounds clean.



Glass plumbing

No big pipe wrench needed here. You mate the joints of this see-through pipe with a small torque wrench. Detroit plumbing contractors are pioneering the tempered-glass piping in industry, with a view to its eventual use in homes. Think how easy it'll be to spot that diamond ring that slips off in the basin and slithers down the drain.



Here's how new materials, ready-made for the inventor, can start those royalty dollars flowing in

Now—Inventing Is Easier Than Ever!

By Norman Carlisle

WHAT'S happening to the independent inventor? Is he a dying breed, losing out in the face of competition from team research in the big industrial labs?

Not at all. The Patent, Trademark and Copyright Research Foundation, setting out to look into the whole business of who's doing the inventing in America today, found that, in the past decade, 40 percent of all patents went to independents—men working alone. The Yankee ingenuity that has always made Americans the inventingest people on earth is breaking out all over the place.

"The ranks of basement inventors run a wider gamut than ever," was the way John Tigrett, perhaps America's leading invention broker, put it to me. Among the 16,000 idea-getters Tigrett deals with each year, he lists lawyers, teachers, truck drivers, housewives, journalists, engineers, airline pilots, and business executives—a full occupational and educational spectrum.

Moreover, the inventions developed by individual inventors, most of whom have never seen the inside of a research lab, cover an impressive range, from tricky gadgets to processes that are changing whole industries. Some have earned a few thousand dollars, some are

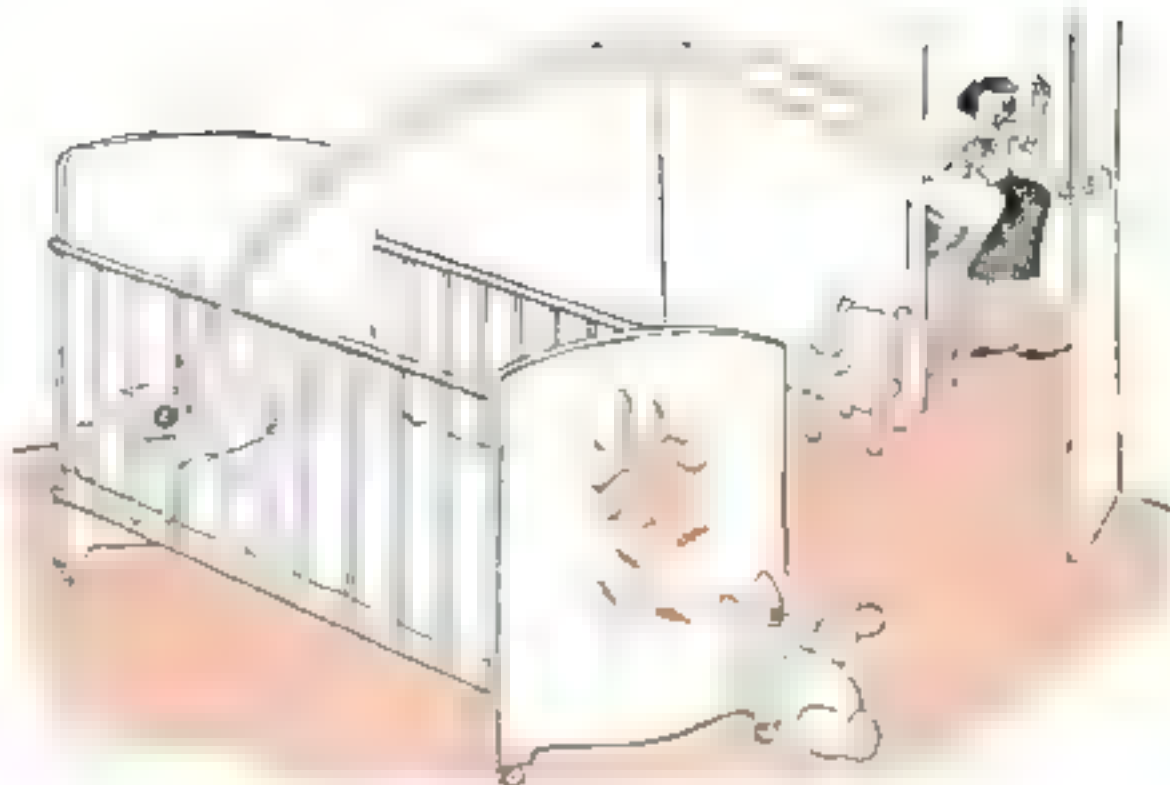
Silencing baby (without violence) is easy with box that produces steady B-flat hum. Transistors made invention possible

bringing in royalties that run into millions.

Inventing is not easy—there are problems that lie between the bright idea and the checks in the morning mail, among them the fact that it takes about three years to get a patent. But in many ways inventing is easier than it used to be. Whether you're a weekend home-workshop tinkerer, or a trained technical man who chooses to go it alone, you've got factors working for you.

Some areas, of course, are the almost exclusive province of big-lab research. You're probably not going to develop another nylon, discover a new plastic, or make a portable reactor in your basement. But the very fact that team research is turning out so many new products—plastics, metal alloys, wonder chemicals, transistors, miniaturized batteries, and a host of other materials and devices—gives you new inventive opportunities.

I got dramatic evidence of how they're being used by today's independents when I investigated the experiences of



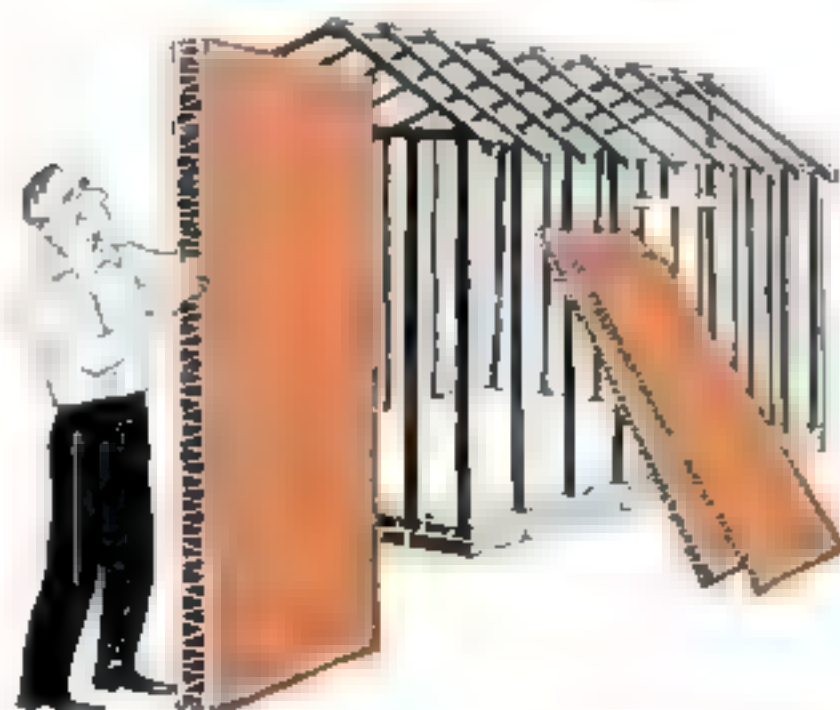
more than 100 currently active, successful inventors.

Building a paper house. Take Harold Humes and his paper house. Humes, a writer with a technical turn of mind, didn't have to invent the makings for his new kind of dwelling. That was done for him by chemists for the big concerns that turn out treatments for making paper water-, fire-, vermin-, and just about anything-proof. When Humes got the idea that such paper would make a fine summer cottage, or low-cost house for underdeveloped areas, all he had to do was design corrugated, honeycombed panels and work out a method of fastening them together with metal straps.

It took a lot of doing, of course, before Humes solved all the problems of making paper pillars, floor, and roof—but he had all the ingredients and the help of the companies that manufacture them. The result is 27 different patents, or patents applied for.

A Texan named Edwin Foster has struck it rich by finding new uses for the marvelous alloys of the steel metallurgists. Among his 50 recent patents are many for special steel springs, which Foster has found a way to coil. They are employed in such items as long steel tape rules (Foster's springs are used in all that run over 12 feet) and the hose-retracting mechanism used on new gasoline pumps in service stations.

When an aluminum window got stuck, Foster figured that "there must be a bet-



Huffing and puffing weren't required to test inventor Harold Humes' paper house. The work on the materials had already been done for him.



Everybody's in the act these days. Truck drivers, business executives, housewives, pilots—they're all busy inventing new gadgets.

ter way to get this thing up." There was. Foster did it with a ribbon of stainless steel, a device now widely used.

When Foster saw how easy it was for electric irons to get pushed off ironing boards or to be forgotten on them, he dreamed up another spring device. It lifts an iron off the board as soon as the user lets go. This invention, sold to a big appliance maker and now in production, took years of work on Foster's part. But his job of making a spring that could lift when required to do so, but not resist the ironer, was made easier by the availability of the special type of steel he used.

Sculpture in a kit. A new plastic resin brought New Yorker Charles Powell's invention to reality. Powell had hit on an idea for making anyone a sculptor. There was nothing new about a figure assembled by joining premolded plastic

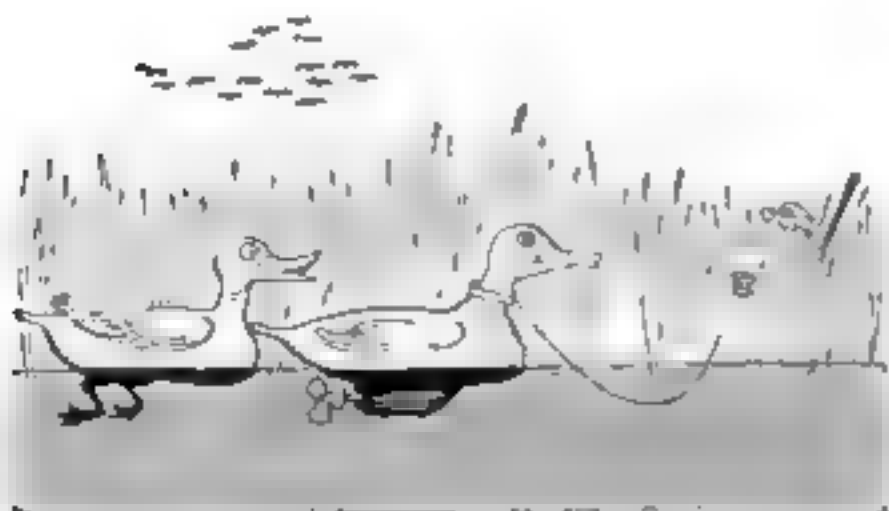
components together. They had long been on the market. The trouble was that when you got them together they looked like what they were. Powell had a better idea: Let the person assemble the parts and then cover them with a material that would hide the joints. What kind of material? Powell didn't know, but he thought that the answer was to imbed small particles of wood, metal, or stone in some kind of paintlike plastic that would set after application. He found a chemical company that made a vinyl resin that could serve as the binder he wanted. A $\frac{1}{16}$ - to $\frac{1}{8}$ -inch coating, applied with a brush, made a piece of sculpture look like the real thing. The sculpture was weighted by sand poured through an opening, which was covered by the coating.

Simple? Yes, but it was a patentable invention which, while it may not make Powell rich, will certainly give him a handsome return on his time.

In recent years a number of research labs have come up with new cements and glues—marvels of stickiness that will fasten almost anything to almost anything. They've been a boon to home craftsmen, industry, and amateur inventors.

James Severino of Encino, Calif., decided that the method of installing electrical conduits, receptacles, and outlets with nails, screws, or clamps was pretty

[Continued on page 193]



Invention for the birds: These mobile duck decoys with motors and propeller shafts use tiny batteries and motors on the market.



Pigmy among giants is this '63 Indy contender, designed and built by Mickey Thompson. It has 12-inch wheels, is 33 inches high and 11 feet long. The 1,050-pound speedster develops over 350 hp. from a modified Corvette engine.

Brand-name engines will compete this year to give Indianapolis Speedway crowds the thrills Dad got

By Henry B. Comstock

COME Memorial Day, a quarter of a million railbirds will gather in the stands and in the infield of the Indianapolis Motor Speedway. They will litter the place with empty coke bottles, bales of paper, and remnants of hot dogs—and, as usual, it will take all June to sweep up after them.

They will be there to watch the most famous of all U.S. automobile races on the most famous of all U.S. race tracks, the "Indianapolis 500." They also will be there for an answer to a question.

Can an invading group of nonconformist race cars, most of them powered by engines originally designed in Detroit's passenger-car factories, sweep the classic racing engines off the track—as brooms

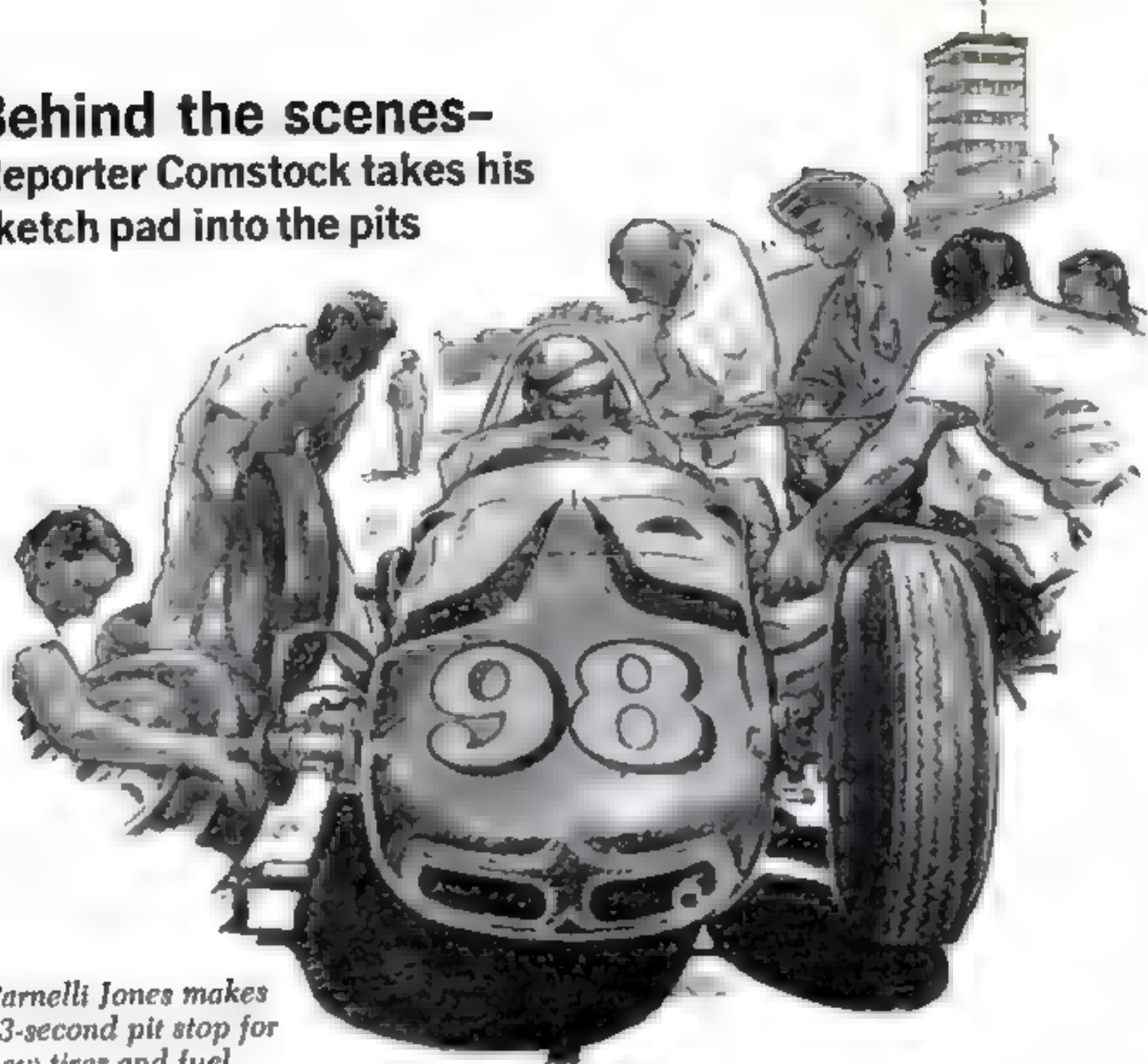
will clear away the spectators' debris?

For a quarter of a century, practically all "500" cars have been propelled for their 3½ hours on the oval by four-cylinder, specially tooled engines that have come to be known as Offenhausers, or "Offies."

These engines are almost mirror images of an engine that first won the "500" in 1934. That engine began as an eight-cylinder job in 1922 on the sketch pad of a man named Harry Miller, became a four-cylinder engine a few years later under a designer named Fred Offenhauser, and today is manufactured by a brace of Californians, Lou Meyer (himself a three-time winner of the "500") and Dale Drake.

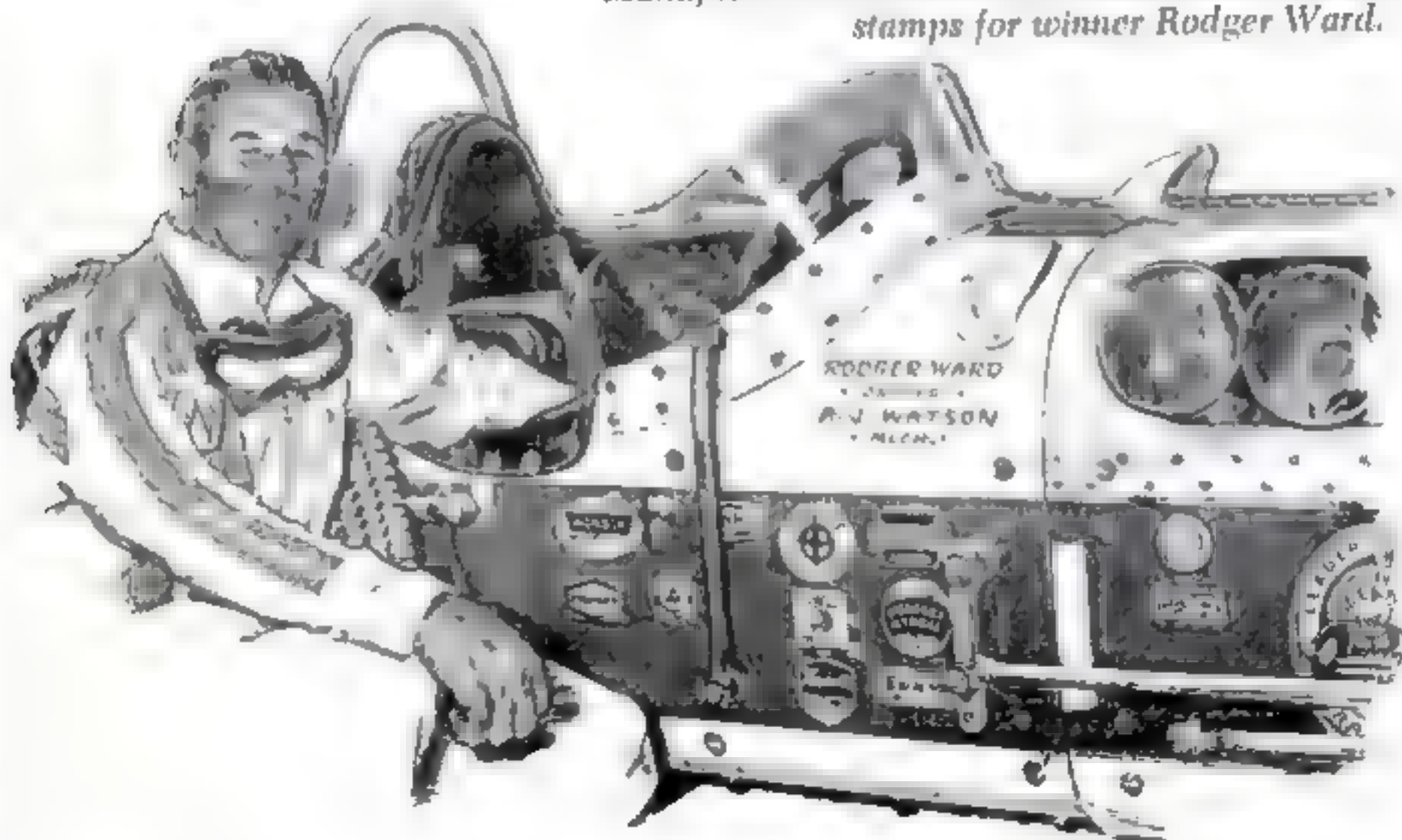
Occasionally, in the annual melee of the 33 starters, there has been a maver-

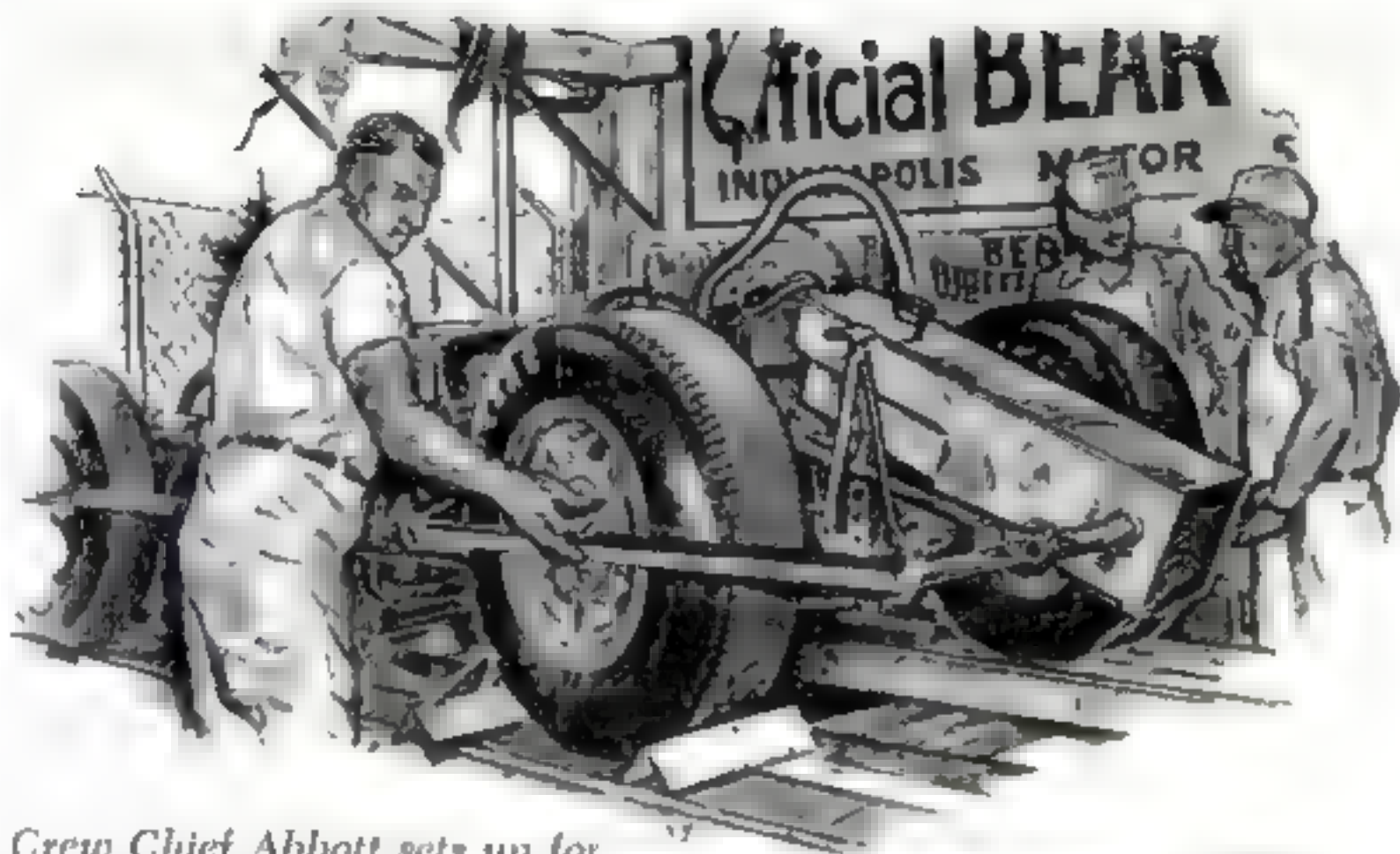
Behind the scenes— Reporter Comstock takes his sketch pad into the pits



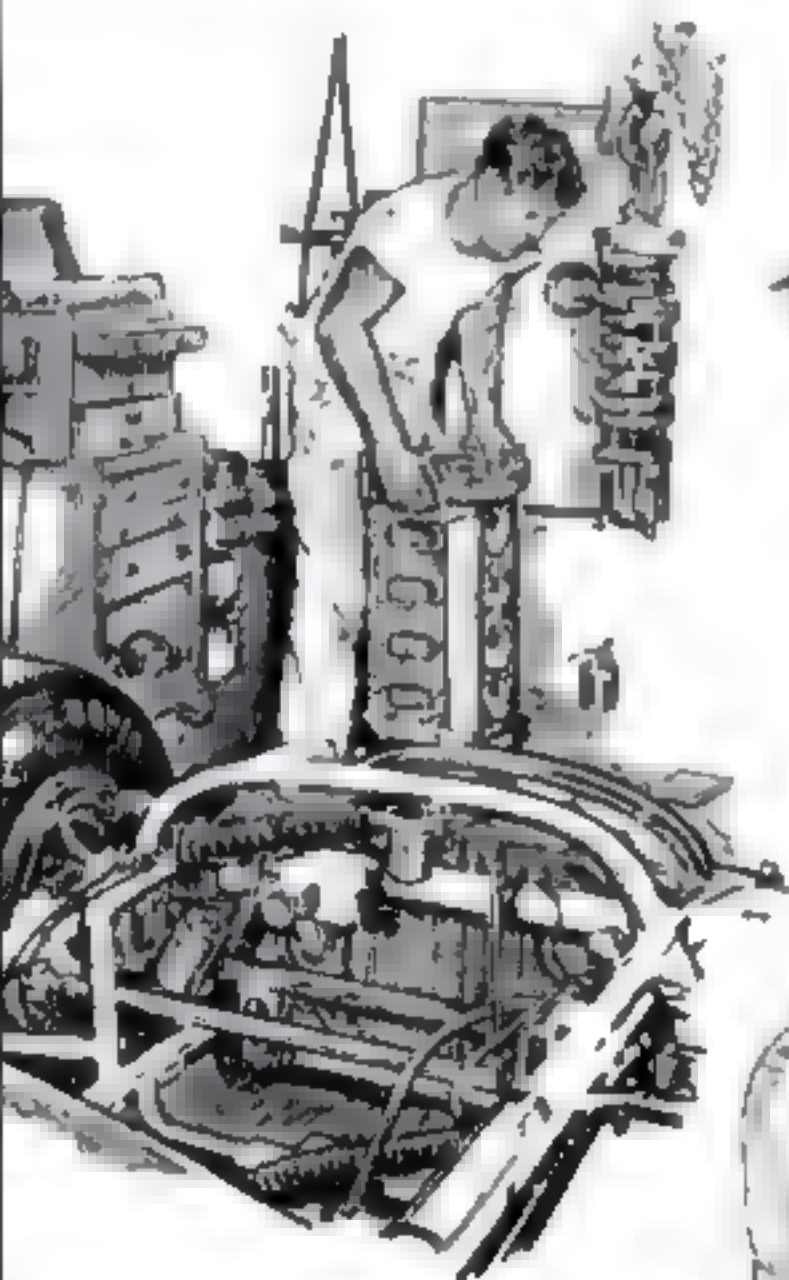
*Parnelli Jones makes
23-second pit stop for
new tires and fuel.*

*Manufacturers' emblems are redeemable trading
stamps for winner Rodger Ward.*





Crew Chief Abbott sets up for Bear alignment check.

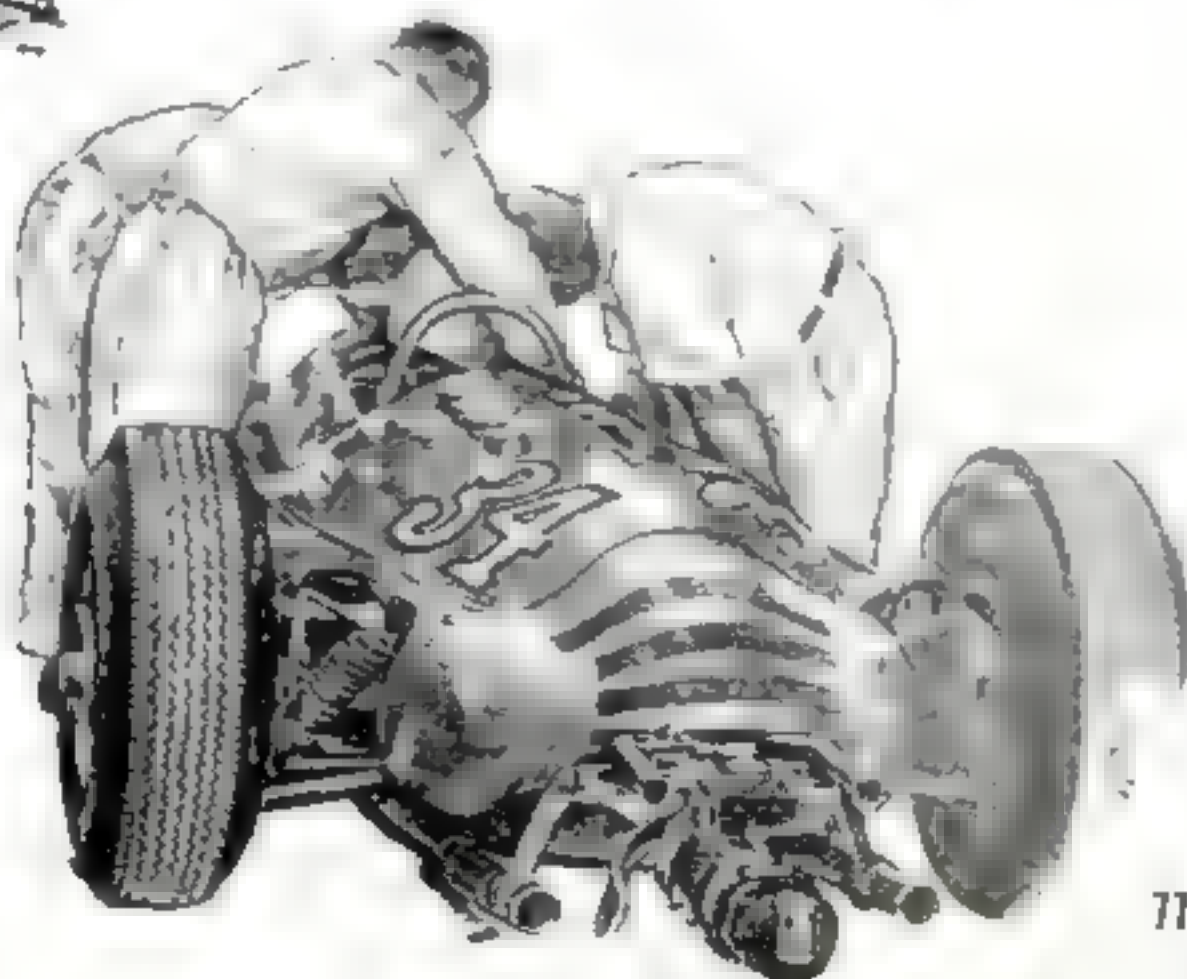


Bud Moyer hefts banger block of A. J. Foyt's One-Spot.



Mickey Thompson finds cockpit of lightweight he built as snug as a spaceman's capsule.

Crewmen strap Dan Gurney in, as portable starter stands ready to stem-wind engine.



CONTINUED

ick. There were V-8s, unrelated to anything that Detroit produced. There were even diesels.

But mostly, since 1937—when the last of the Detroit-designed engines (those of Studebaker, Ford, Hupmobile and Hudson were the most prominent) stopped competing—they have been Offenhausers.

Now, for the 1963 event, modified Detroit engines are once again back in the running in an effort to give the Offies their lumps. Here's a roster of them:

- Five Harvey Aluminum Specials, designed and built by Mickey Thompson of Long Beach, Calif. These are rear-engine jobs, propelled by aluminum versions of the Corvette 327-inch V-8. With their cubage reduced to 256 to meet Indy maximums, horsepower will be around 350.

Two of the five cars are the same ones that competed in 1962. They have their same 15-inch wheels. Three will have tiny 12-inch wheels that make them look like Soap Box racers.

Maximum engine revs have been greatly increased by using forged-aluminum, rather than cast-steel, rocker arms. Stronger—and easier on shafts, springs, and oil temperatures—these parts are also 50 percent lighter. Two of the roadsters are modifications of cars Thompson entered in last year's race. At that time they were powered by Buick engines. One qualified and, with versatile Dan Gurney as wheelman, did well until the 96th lap, when it crippled out with a faulty gearbox seal. The other two are completely new in contour, suspension, and steering control.

- Two rear-engine roadsters cradling Buick power plants. These engines are 215-inch aluminum V-8s, bored out to 256. Horsepower is 330 at 6,500 r.p.m. Both cars are sponsored by sportsman Jim Kimberley. One is a Thompson-built sister of last year's Harvey Aluminum Specials. The other is a copy built this year.

- Two rear-engine Lotus "Indy Project" Specials, built by the English manufacturer. Their Ford Fairlane V-8s,

similar in design to a currently offered 289-inch engine, will be sized at 256 inches and generate 350 hp.-plus at a usable range of 6,000 to 8,000 r.p.m.

Maverick V-8s, one from Europe, also are back:

- One Cooper. This is the same English machine Jack Brabham drove so ably in the '61 Indy, finishing ninth in spite of inadequate horsepower. With 167-inch displacement, his unblown Climax V-8 delivered a meager 252 at 6,300 r.p.m. After the race, Brabham said he would have needed another 100 horses to give the competition back-talk on the straightaways. Mexican driver Pedro Rodriguez, winner of this year's Daytona Continental, will get a better break. For an Aston-Martin V-8 engine that wrings 370 horsepower from 275 inches has been installed by the Cooper's present owner, Kjell Ovale.

- Three greatly modified Novi V-8s, championed by Andy Granatelli, a vice-president of Studebaker. For years the Novis have been hard-luck machines. Often they have not even got beyond their qualification laps. The last Novi to compete finished tenth in 1958. Originally built with front-wheel drives, their engines were supercharged.

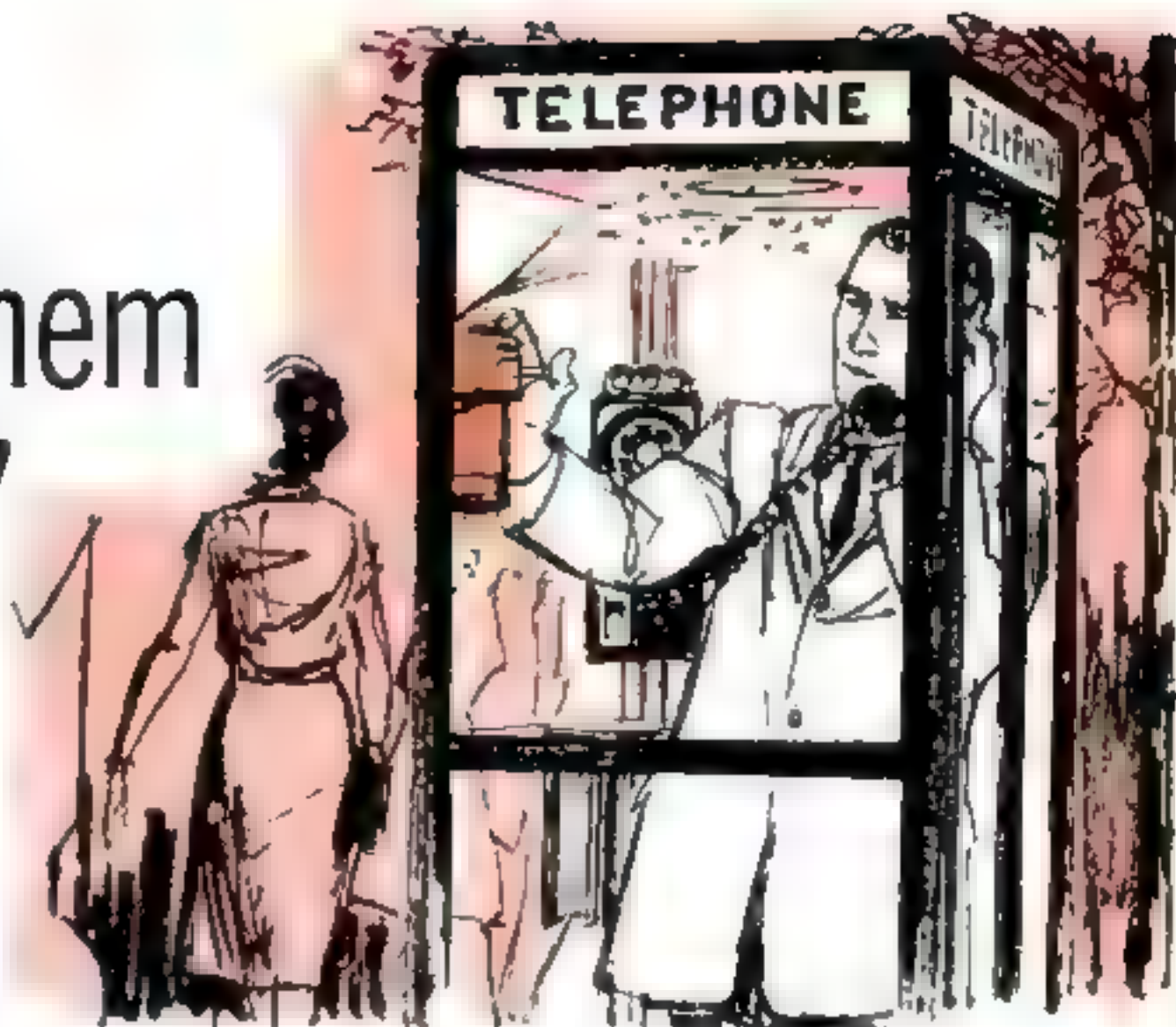
Sidelined for four years, the Novis are still supercharged, no longer are driven by the front wheels. The cars have been rebuilt. Weight has been reduced from 1,800 to 1,650 pounds. With a new carburetion and supercharger setup, the horsepower of the big-muscled V-8s is smaller but more tractable than last year's 745. It still stands at a whopping 635. Other changes include dual brakes, improved steering, and a radically different type of headrest assembly.

Enthusiasm vs. sobering facts. The optimism of race-car designers is proverbial. But this year it approaches exuberance. Before the '62 contest, Thompson told me he'd be happy if one of his lightweights completed the 200 laps. Today he says: "Now we've got what it takes to win—the perfect team."

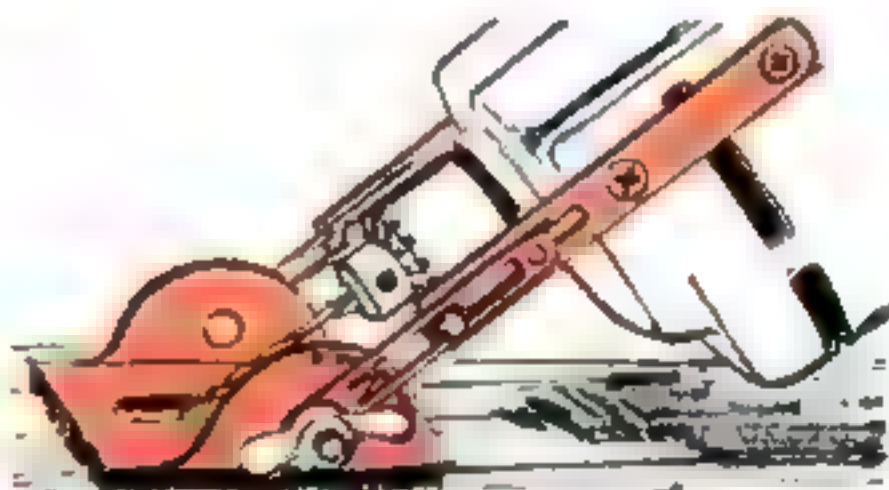
[Continued on page 204]

"I'd like to see them make..."

Bug bombs for phone booths that would spray at the drop of a coin. I'd gladly spend a penny to get rid of insects drawn by the light at night.—C. Petzold, Runnemedede, N.J.



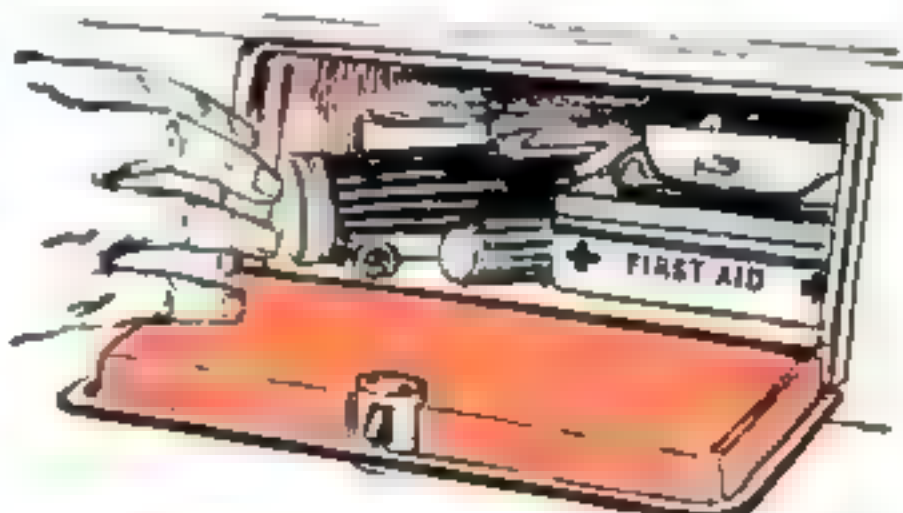
Easy-to-tote fishing gear—fishing net, boat hook, and gaff designed as snap-on heads so you could use 'em all with a single pole.—Anthony J. Santoro, Farmingdale, N.Y.



An angle jig for use with electric hand drills. The arms would telescope as the bit entered the work; graduations could indicate the depth drilled.—R. Knudson, Hanover, N.H.



A clipping catcher for my electric hedge trimmer. It would eliminate the bother of raking up and picking bits and pieces out of the hedge.—R. M. Woodbury, Natick, Mass.



Padded glove compartments in cars. A plastic foam-backed liner would keep hard objects from rolling so readily and rattling against the metal sides.—Art Tussey, Richmond, Va.

Everyone has his own pet idea of a gadget that he would like to see in general use. What's yours? We will pay \$5 for each one published. Please use Government postcards

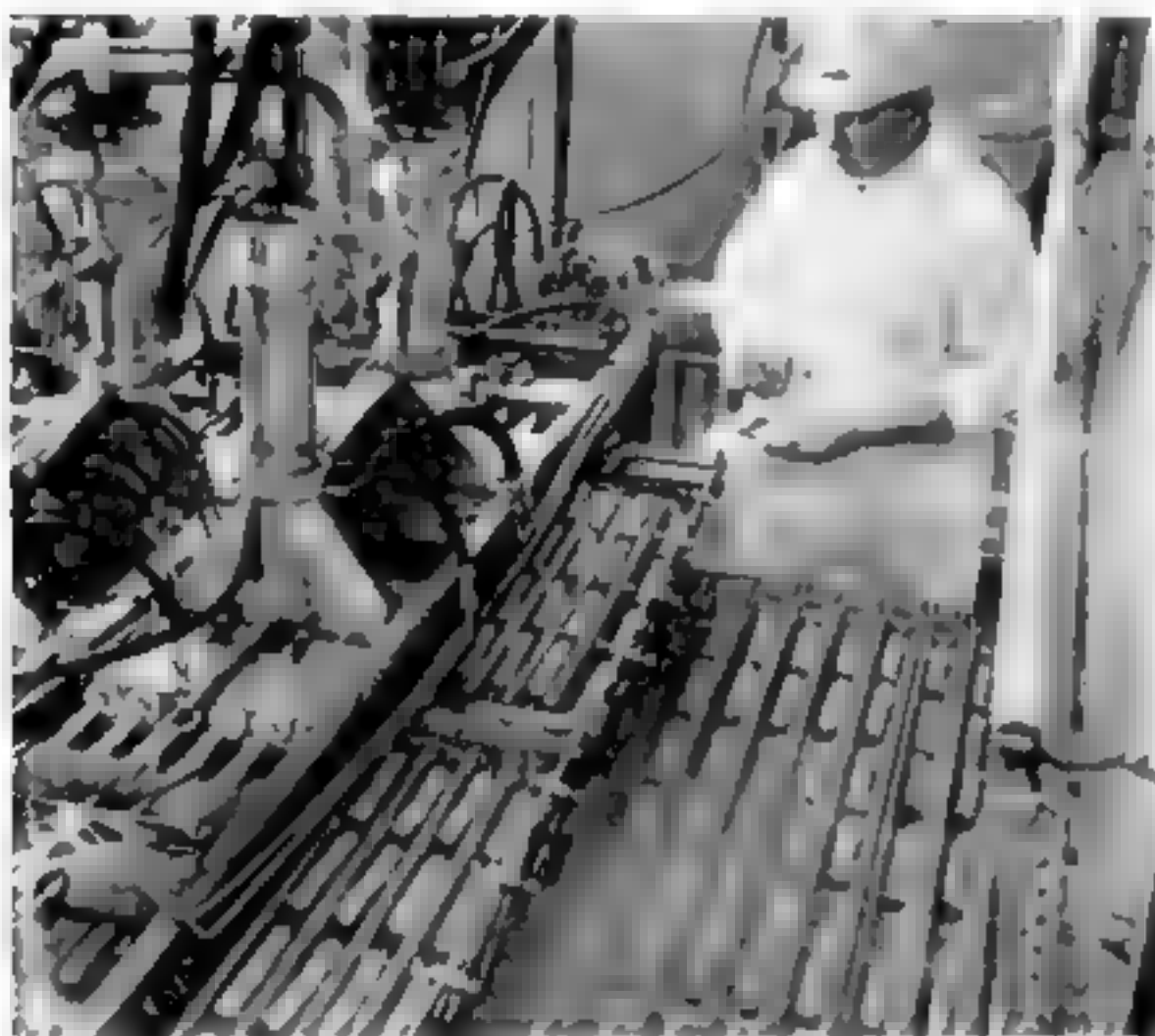
only. Send to ILTS Editor, Popular Science, 355 Lexington Ave., NYC 17. Write your name and address clearly. Contributions cannot be acknowledged or returned.



Navy cruiser launches three missiles at a time

Three surface-to-air test missiles are launched here, for the first time, simultaneously from one ship. A Bendix Talos streaks out from the bow, another from the stern, and a General Dynamics Tartar from amid-

ships. The vessel is the U.S.S. Albany, one of three heavy cruisers newly converted for multiple guided-missile launching. She shows her triple punch off the Virginia Capes before joining the U.S. Fleet.



Automation comes to the hot-dog factory

Ground meat goes in at far left, comes out in foreground as frankfurters. The skinless franks are made on electronic machines installed in Swift & Co.'s plants. Meat is pumped in, formed in molds, solidified, and dropped onto the conveyor here which takes the dogs to cooking, smoking, chilling, and packaging stages. No human hands touch them anywhere along the line.



Microwave tower is nation's biggest talker

This building, with its 185-foot tower dominating the Los Angeles skyline, is the Pacific Telephone Co.'s new \$31,000,000 communications center—largest in the country. The tower, called officially a microwave-radio antenna support, has five "horns" on its top. They transmit and receive nationwide teletypewriter, telephone, television, and radio messages.



Diving robot drills for oil under sea

This underwater robot is going down off the coast of California to drill and complete an offshore oil well. Shell Oil's mechanical roughneck can see, hear, and swim; and its arm can turn lock screws, operate valves, grip pipe and hose, or weld a wire brush and other tools just like a man, but by remote television and sonar control from a drilling ship on the surface.

The robot's principal advantage over human divers? It can go deeper—down to 1,000 feet—and stay down longer. Shell expects the system to revolutionize offshore-oil prospecting.



Wheeled boat rides on land or water

Dubbed the Husky Duck, this car-boat was built especially for hunters and fishermen. It has a plastic-and-wood frame four feet wide and eight long, and rides on six low-pressure vinyl tires with fins on the sides for propulsion. Neumann & Bennetts, Berkeley, Calif., sells it for \$1,395, but if you want to build one yourself you can get plans. Tires sell for \$24.95 without wheel.



Powerful water jet saws through wood

Having drilled holes with a light beam [PS, March], the University of Michigan is now sawing wood with a stream of water. The .01-inch jet in the rig above has a pressure of 50,000 pounds per square inch, moves at a speed of 3,000 feet a second. Here it cuts through a two-inch maple plank, severing the fibers without leaving sawdust.

It happened 40 years ago this month

The First Nonstop Coast-to-Coast Flight

IN THESE days of five-hour transcontinental jets, it seems incredible that the first nonstop coast-to-coast flight was made only 40 years ago.

The plane was a Fokker T-2 with an open cockpit for the pilot, who sat to the left of the 400-hp. Liberty engine, where he could make minor repairs in flight. The copilot sat about 10 feet behind.

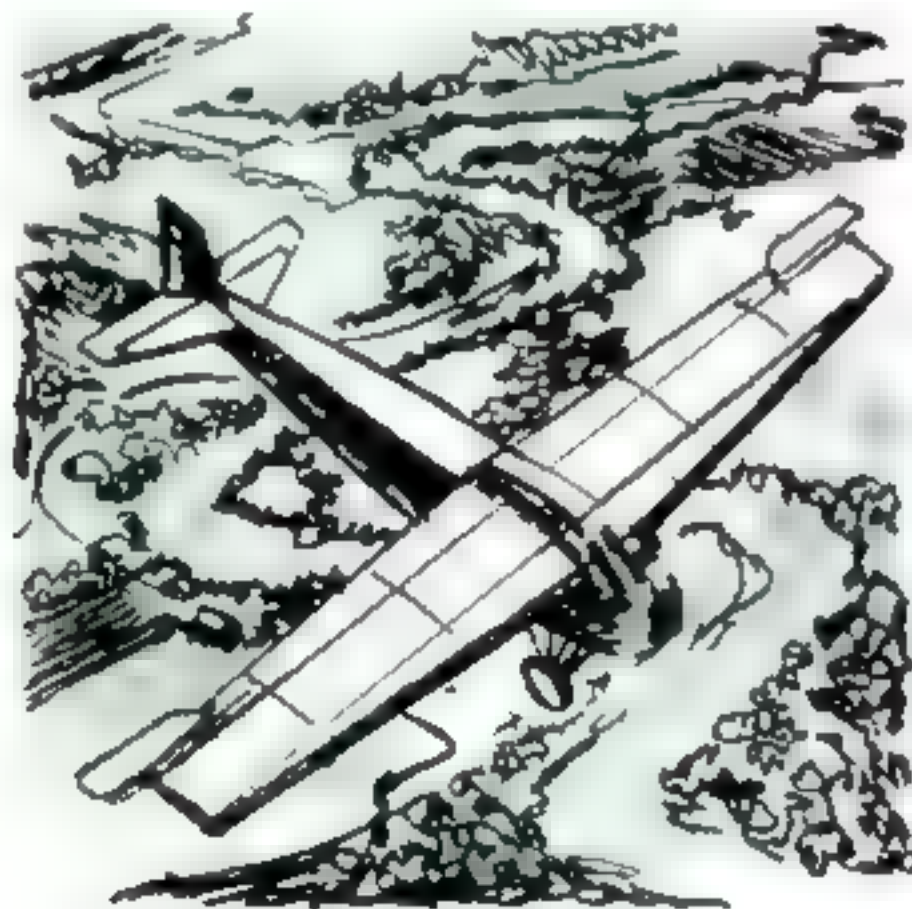
The aviators were Lieutenants Oakley G. Kelly, 31, and John A. Macready, 35, of the Army Air Service. Today both are retired Air Force officers.

Twice they took off from San Diego, and twice they failed to complete the flight.

On their first try, fog obscured the mountain passes through which they had planned to fly; and with their plane's 10,000-foot ceiling they couldn't climb over the mountain tops. So they circled over San Diego and set an endurance record of 35 hours, 18 minutes. "We didn't have the nerve to return at once after being handshaked and slapped on the back," Macready said.

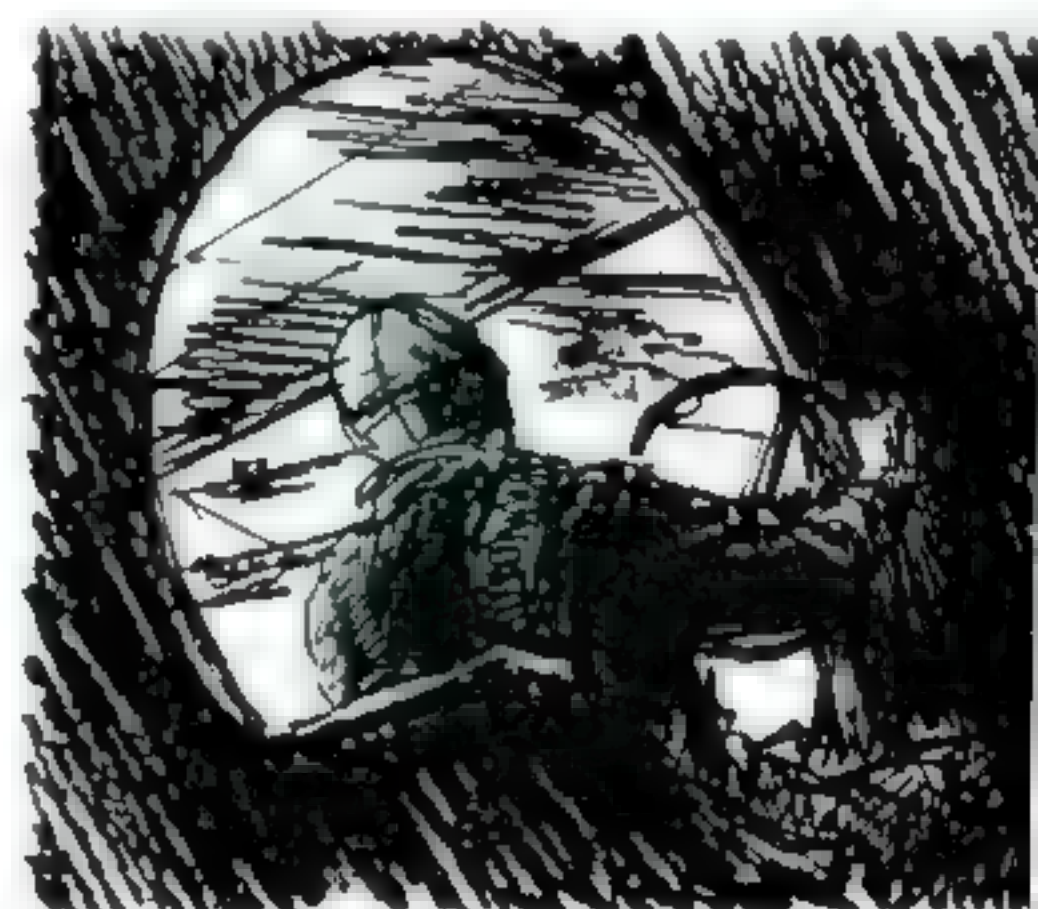
On their second flight, the engine leaked coolant and overheated. They poured in coffee and even consomme, but finally had to land on the Indianapolis Speedway.

On their third try, this time from east to west, they made it.—Gardner Soule.



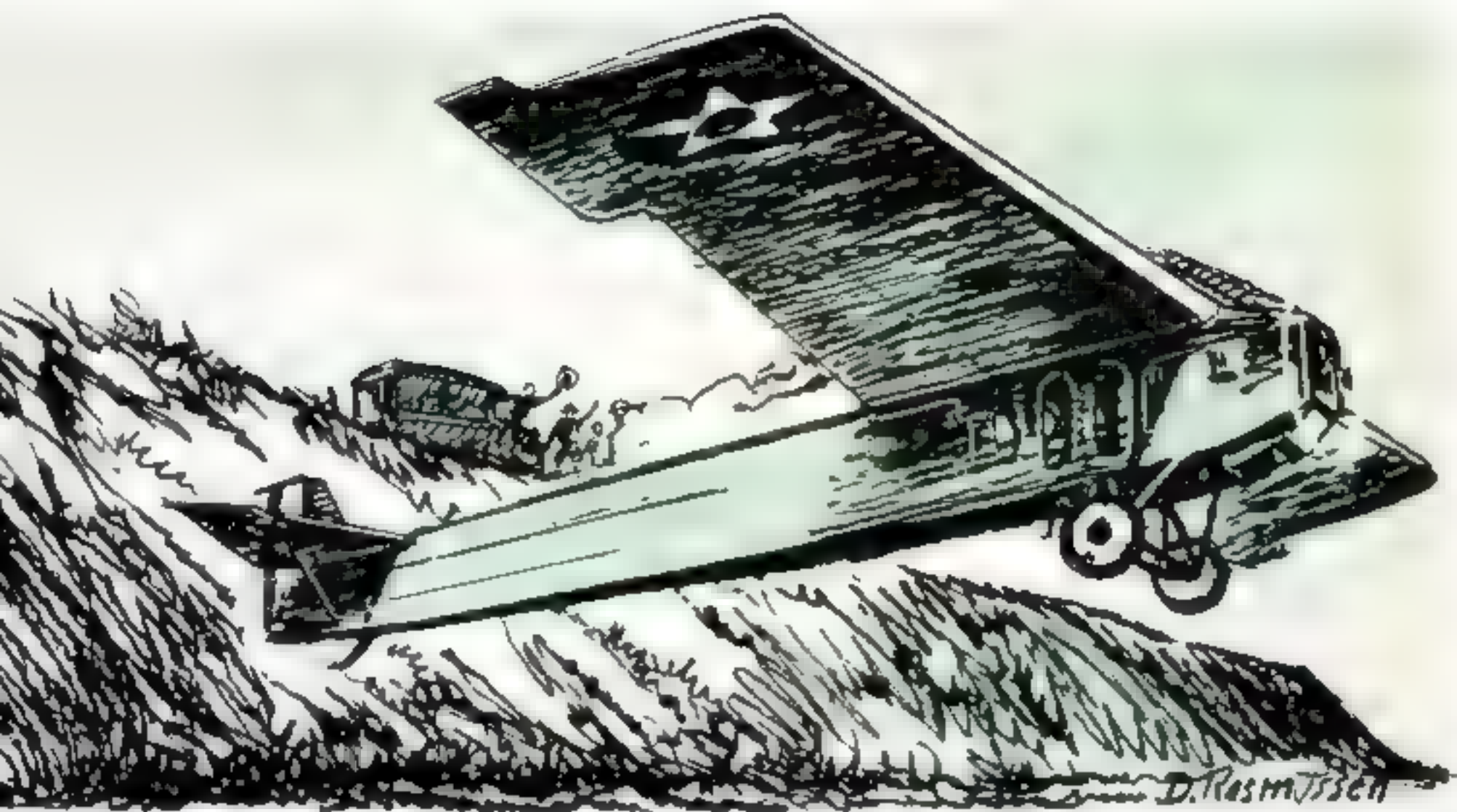
A long struggle to gain altitude

Limping low over Long Island, the overloaded plane skimmed above telephone wires. It managed to climb all the way up to 300 or 400 feet to clear the roller coasters and Ferris wheel of Coney Island. By the time the T-2 reached Pennsylvania, it had gained a little more altitude. Visual navigation was difficult: "Rivers, roads, and railroad tracks wound in all directions," complained Macready, "and the large cities were covered with dense smoke."



Making a repair in the air

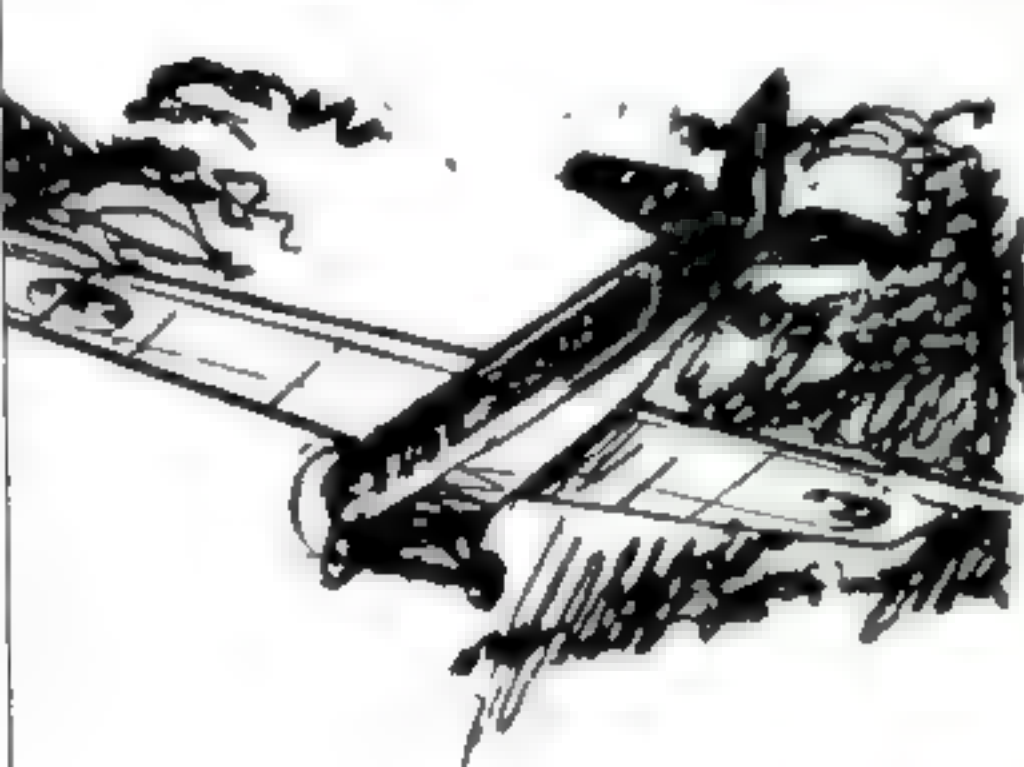
Mechanical trouble came quickly: The engine stopped generating electricity. The batteries would soon be depleted, and the plane would have to land. Kelly removed the voltage regulator and adjusted it—a delicate operation even on the ground. Meanwhile, Macready flew the plane with a second set of controls from the rear seat; he couldn't see ahead or to the right. Within minutes Kelly replaced the regulator. The ammeter registered a charge again.



Start of the historic 2,500-mile flight

On the morning of May 2, 1923, at Roosevelt Field, Long Island, N.Y., Lieutenants Kelly and Macready loaded their T-shaped Fokker with 737 gallons of aviation gas. Ready to fly, the

plane weighed 10,850 pounds. An extra couple of hundred pounds would have kept it on the ground. On the first try, the T-2 failed to take off. On the second try, at 12.36 p.m., it fell off a 20-foot drop-off surrounding the field, clumped out just in the nick of time.



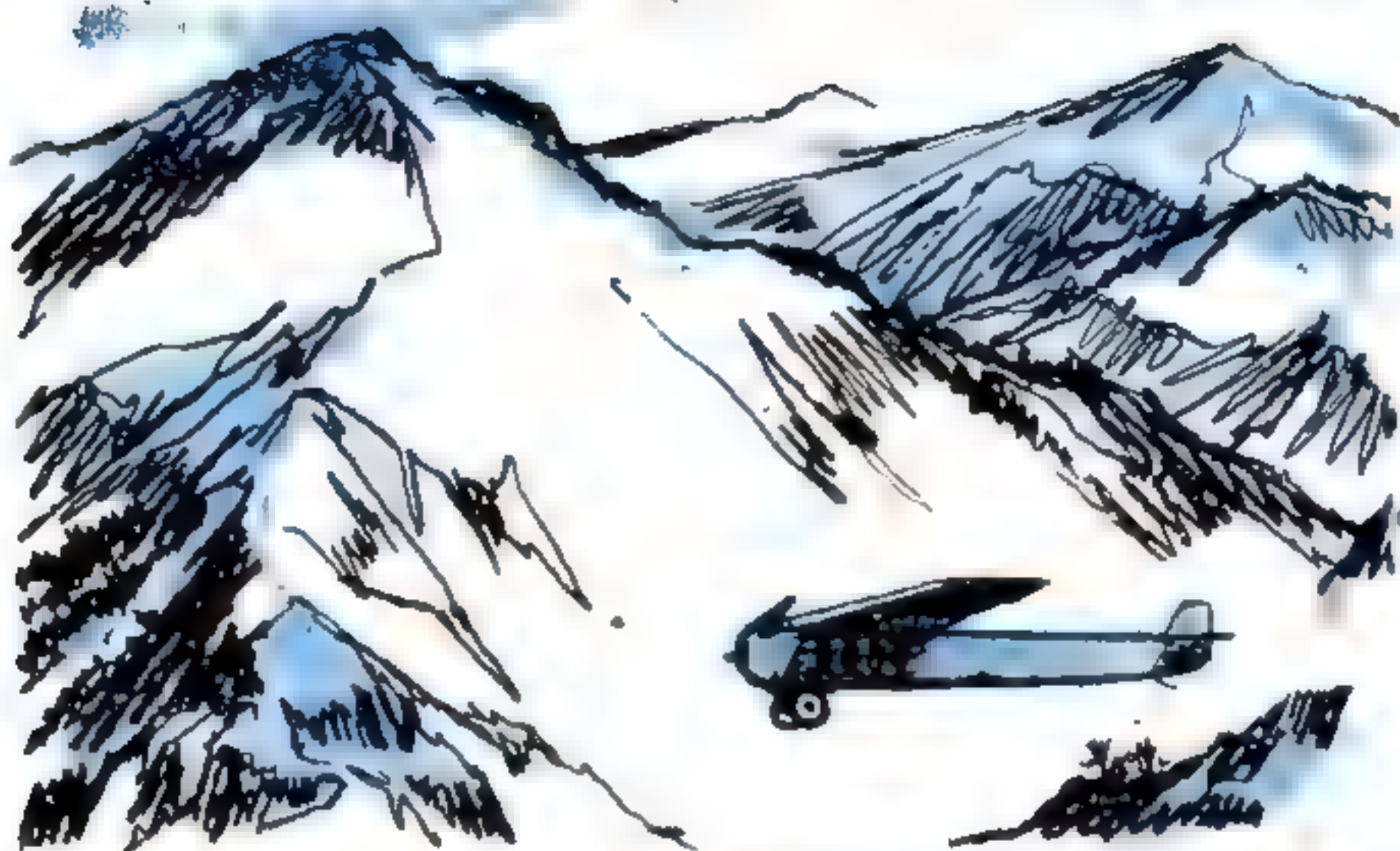
A welcome beacon beckons

Over McCook Field in Dayton, Ohio, their home base, Kelly and Macready dropped a message that they expected to reach their destination, San Diego, by noon the next day. After dark, at Belleville, Ill., a 36-inch, 450-million-candlepower searchlight swept the sky. The beam was off their course, but they flew to it. "The light looked too sociable for a couple of lonesome pilots," Macready reported later. "We couldn't resist heading in that direction."



Night flying across the Midwest

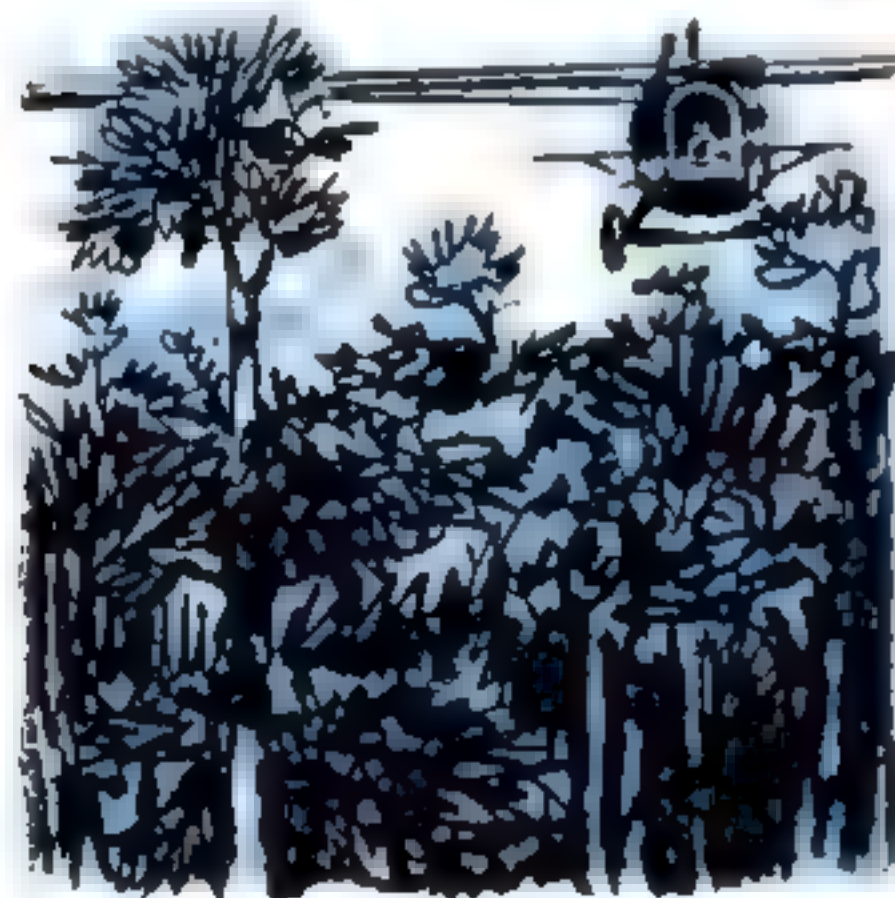
The foggy, murky night had all but a few faint lights when they flew over St. Louis. Then came the Ozark Mountains, with heavy clouds and an icy rain that kept the flyers wiping their goggles. They flew by compass when landmarks weren't visible. In the darkness they couldn't tell whether a wing was pointed up or down or whether the plane was level. The only clue the fliers had to when they were climbing, said Macready, was a drop in air speed.



Mammoth mountain roadblock ahead

Across New Mexico, Kelly and Macready stayed on course by following railroad tracks and the Rio Grande River. Over Arizona, the map showed 8,000-foot-high mountains ahead.

The altimeter indicated 10,000 feet, but the T-2 lacked the power to clear the summits, obviously still higher. Desperately the pilots hunted for passes to sneak through. It was tricky business, with the danger of flying into a dead-end pass with a mountain blocking it at the end.



Coming down the home stretch

Ahead was what looked like a giant lava bed. It was an immense forest on a plateau. The T-2 cleared the tree tops by feet. They searched for a pass to Phoenix but couldn't find one. So they flew due west, picking out the lowest mountains. At last they came out of the mountains over a desert. They caught sight of a landmark: the Santa Fe railroad northwest of Phoenix. At 11:35 a.m., they were spotted over El Centro, Calif. There was only about 100 miles to go.



Mission's end, and a rousing welcome

Over San Diego, the fliers banked the T-2 and swung down the main street. The rooftops 100 feet below were covered with 100,000 cheering, hat-tossing people. Factories and ships in the harbor let loose with their whistles. The T-2 had averaged 93½ m.p.h. across the U.S. The men landed at North Island 26 hours and 50 minutes after leaving New York, and had lunch with the C.O., Maj. H. H. (Hap) Arnold, future chief of the Army Air Forces.



Oversize pebbles pass under watchful eyes—just in case a Koh-inoor should lurk among them!

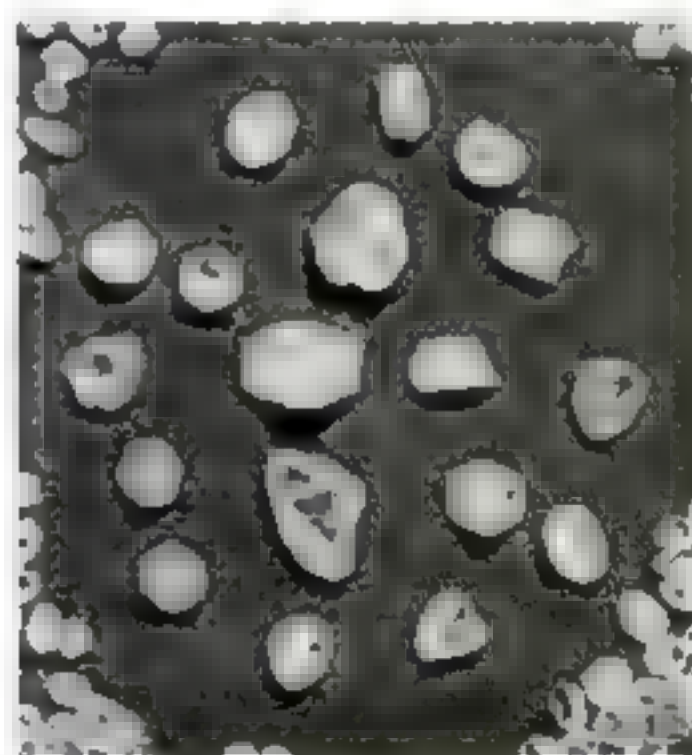
They Fish for Diamonds

Seafaring miners are finding gems worth fortunes beneath the ocean

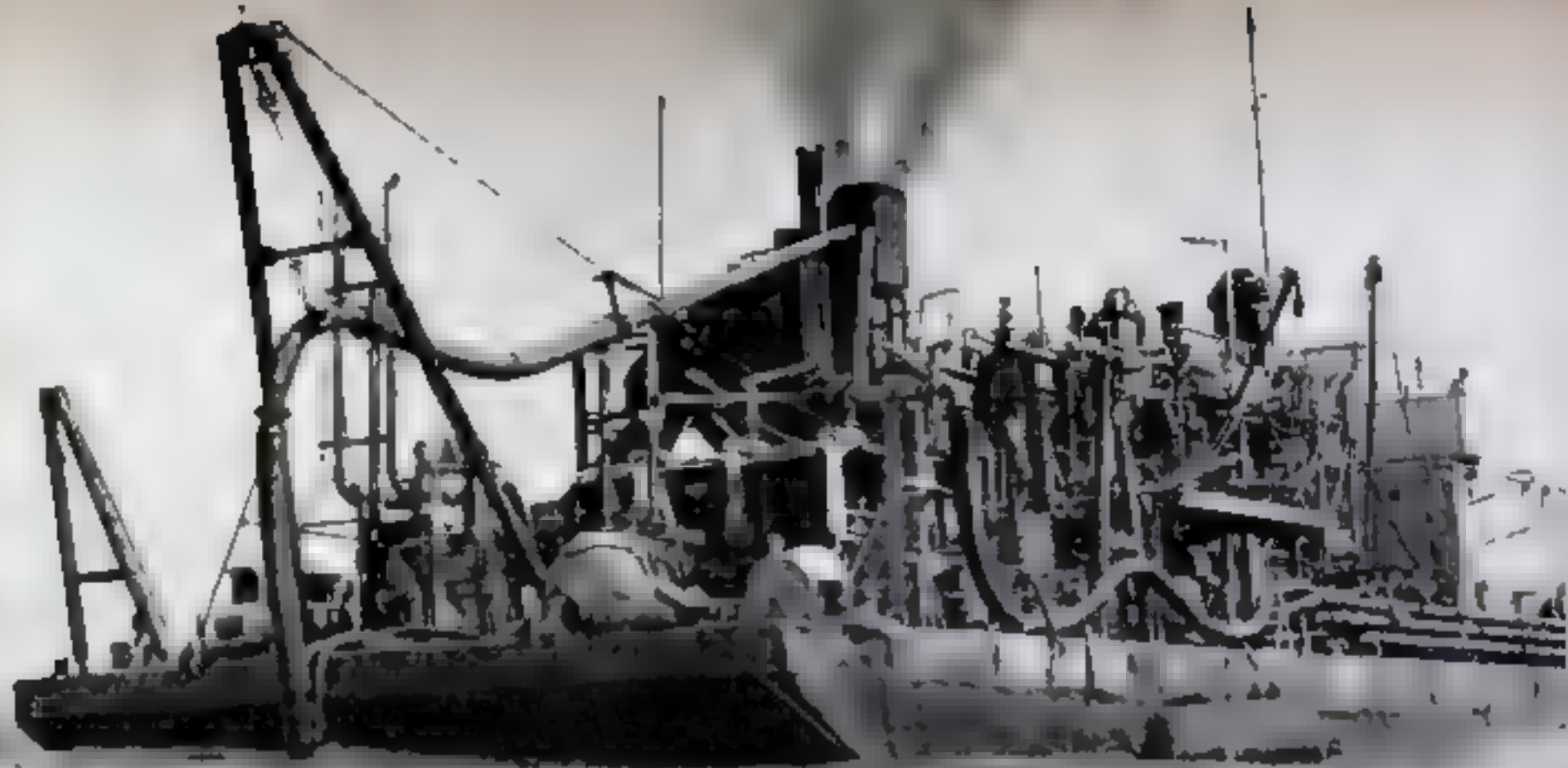
By Alden P. Armagnac

THE diamond that sparkles in a 1963 engagement ring may come from the sea. For one of the strangest mining ventures, a bold project to seek diamonds on the ocean floor off the coast of Africa, has met with success.

CONTINUED



Undersea haul of diamonds includes these sizable trophies of three to nearly five carats—as well as smaller stones in much greater numbers. All these diamonds are of gem quality.



Mining camp afloat, barge Seventy Seven goes into action offshore with 53 men aboard. Typical

In its first three months the enterprise has yielded 11,000 carats of the gems, worth \$3,000,000 at retail.

Three vessels make up the entire mining gear of the Marine Diamond Corp., Ltd., of Cape Town.

A seagoing tug, the 800-ton Emerson K, serves as prospector. Fitted with a tube to suck up samples of the sea bottom, this craft late in 1961 began to cruise off South-West Africa's "diamond coast," from Walvis Bay southward to the mouth of the Orange River. Ashore, the waterless coastal desert of this region has long ranked as a major diamond-mining area where gems by the thousand are found loose in the sand.

The Emerson K promptly confirmed its operators' belief that the diamond field might not end at the beach—by returning with 45 sea-bed gems from pinhead-size up to that of a small pea. Soon a second craft—better suited to recovering the gems in quantity—was exploiting the tug's finds. This is the Seventy Seven, a converted Collins Submarine Pipelines barge.

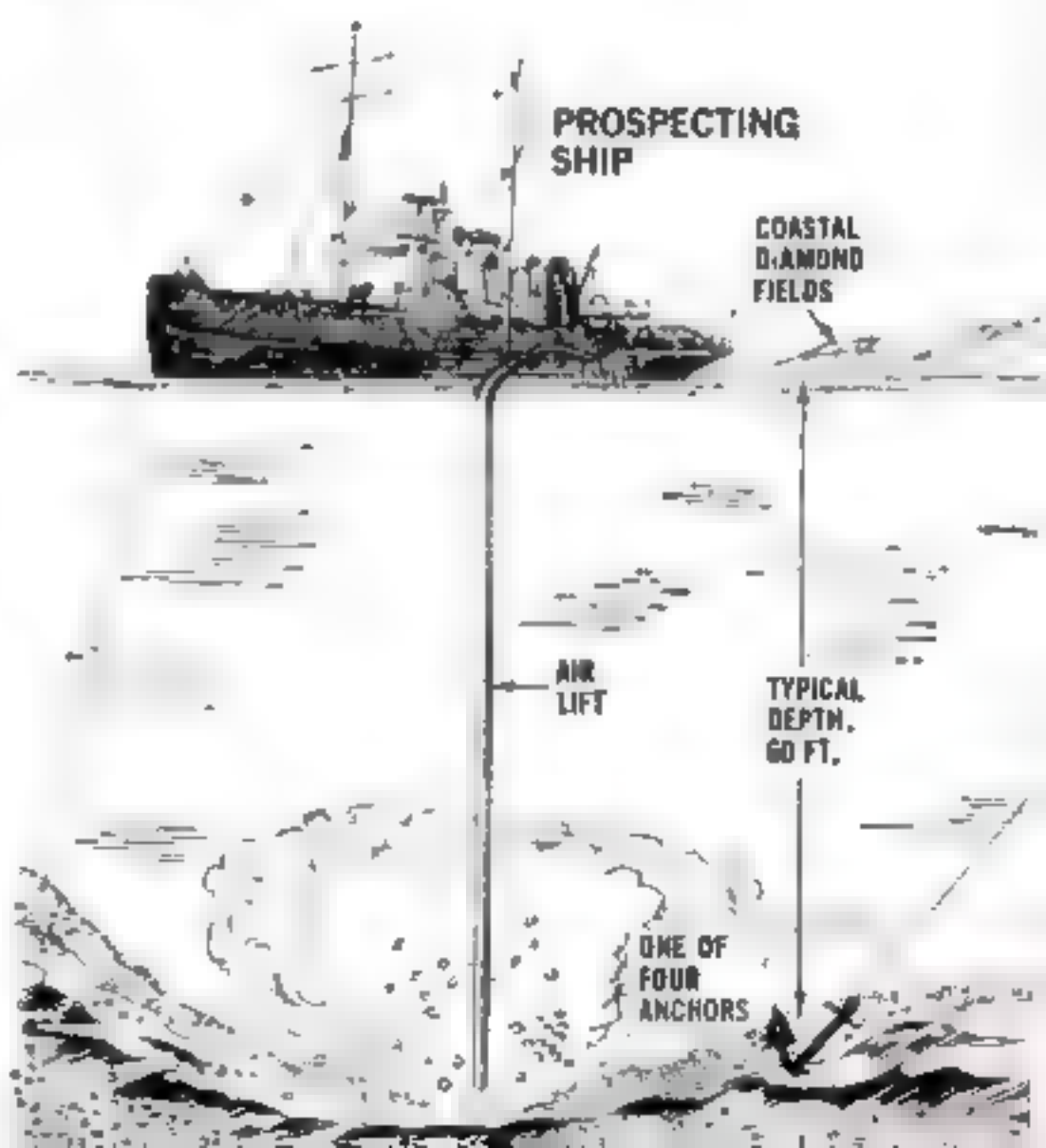
A floating mining camp—population, 53—it's towed to a promising spot. It can then maneuver itself over an area of 4,000,000 square feet by means of a special winch and the cables to its four anchors. Meanwhile its "air-lift" pipe

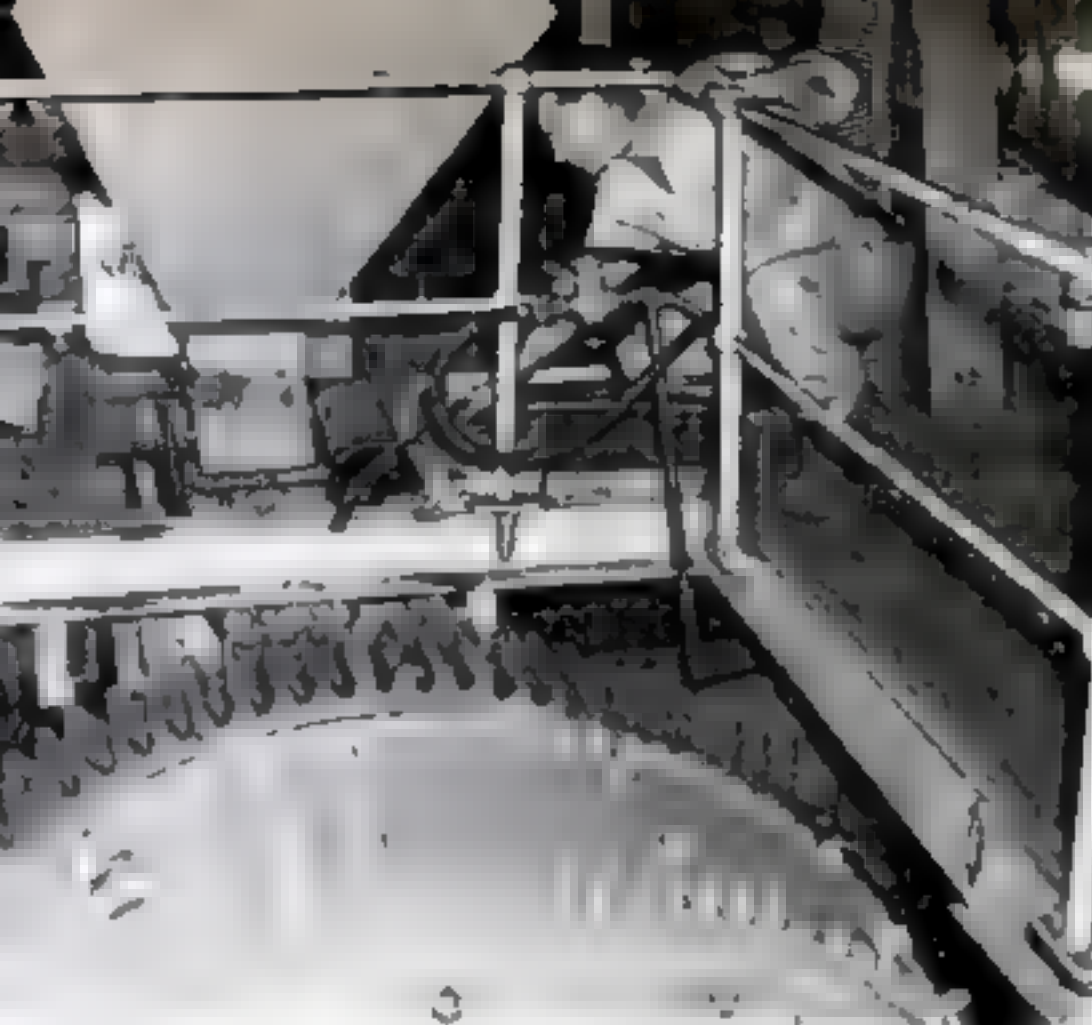
day's haul yields more than 100 carats of diamonds from 50 tons of screened gravel.

brings up diamond-bearing gravel by the ton. A shipboard concentrating plant reduces this bulk until the diamonds can be picked out by hand.

Equipped for a long stay, the Seventy Seven makes its own fresh water and is provisioned for three months. A tender, shuttling between barge and shore, completes the "diamond fleet."

Here's how they mine the diamonds beneath the sea





Ball mill, above, helps remove foreign matter from diamonds. Then jigs take a turn at it.



Hand sorting, picking the diamonds from the concentrate delivered by jigs, is final step.

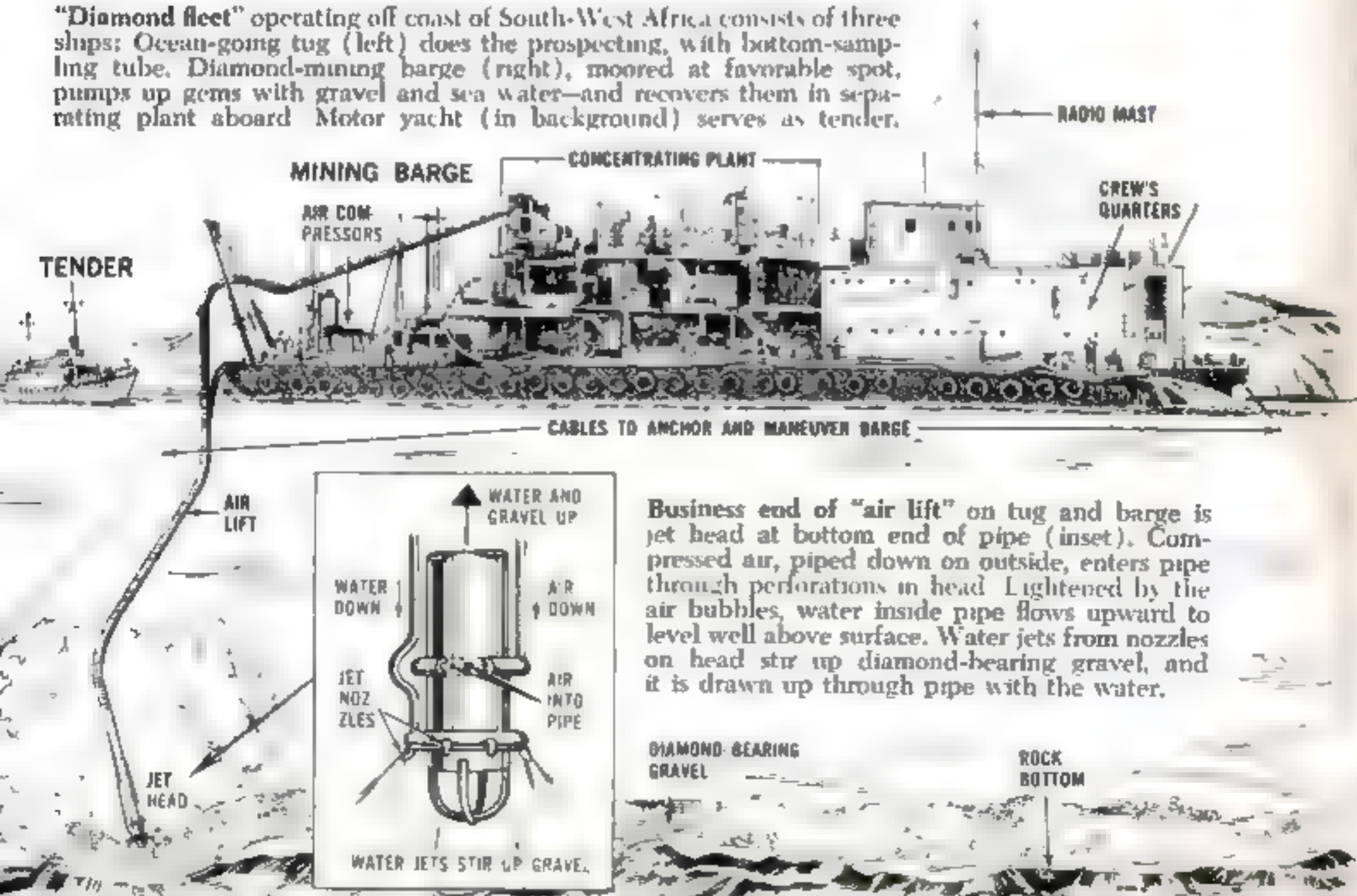
The originator of the underwater mining operation, Sammy Collins of Port Lavaca, Tex., heads a worldwide string of construction firms specializing in submarine pipelines and other underwater projects. His venture into diamond mining, far from an incongruous one, makes good use of this engineering know-how.

The "air lift" that brings up gravel

from 100-foot depth or more goes back in principle to one used in Alaska in 1860. A flexible pipe, open at the bottom, descends from the barge to the sea floor. A separate hose carries down air from the barge's compressors, and discharges it into the water-filled pipe. Since the resulting mixture of air bub-

[Continued on page 182]

"Diamond fleet" operating off coast of South-West Africa consists of three ships: Ocean-going tug (left) does the prospecting, with bottom-sampling tube. Diamond-mining barge (right), moored at favorable spot, pumps up gems with gravel and sea water—and recovers them in separating plant aboard. Motor yacht (in background) serves as tender.



Business end of "air lift" on tug and barge is jet head at bottom end of pipe (inset). Compressed air, piped down on outside, enters pipe through perforations in head. Lightened by the air bubbles, water inside pipe flows upward to level well above surface. Water jets from nozzles on head stir up diamond-bearing gravel, and it is drawn up through pipe with the water.



New ideas from the inventors

Rails brace moving cargo. Slotted rails and telescoping, spring-loaded poles, according to this recent patent, might speed cargo handling, reduce in-transit damage, lessen the need for crating. The rails would be fastened to roof, floor, and sides of a truck or freight car. Snapping pole ends into holes would keep the cargo from shifting.



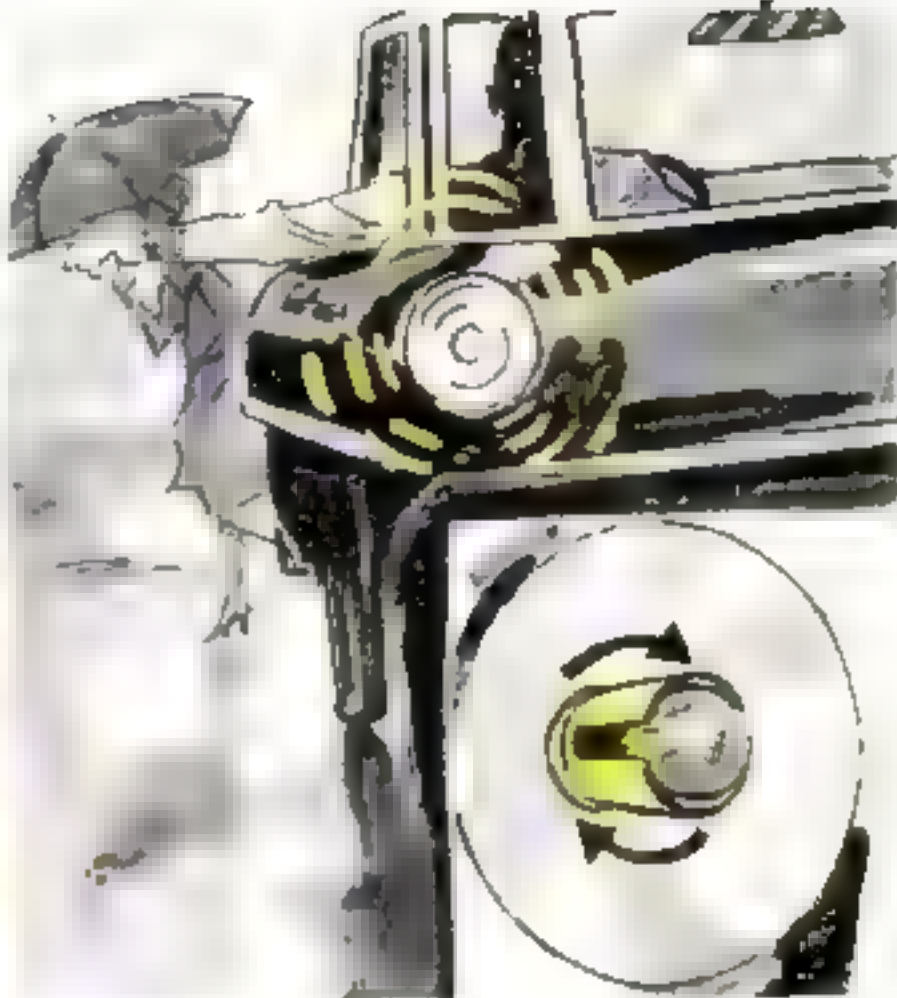
Freezer signal warns of thaw. This indicator would tell if power failure had caused a dangerous temperature rise in your freezer—and for how long. After freezing the sealed-in liquid, you'd invert the clear-plastic cylinder. Thawed liquid would drain past a supporting spider into the time-calibrated lower half.



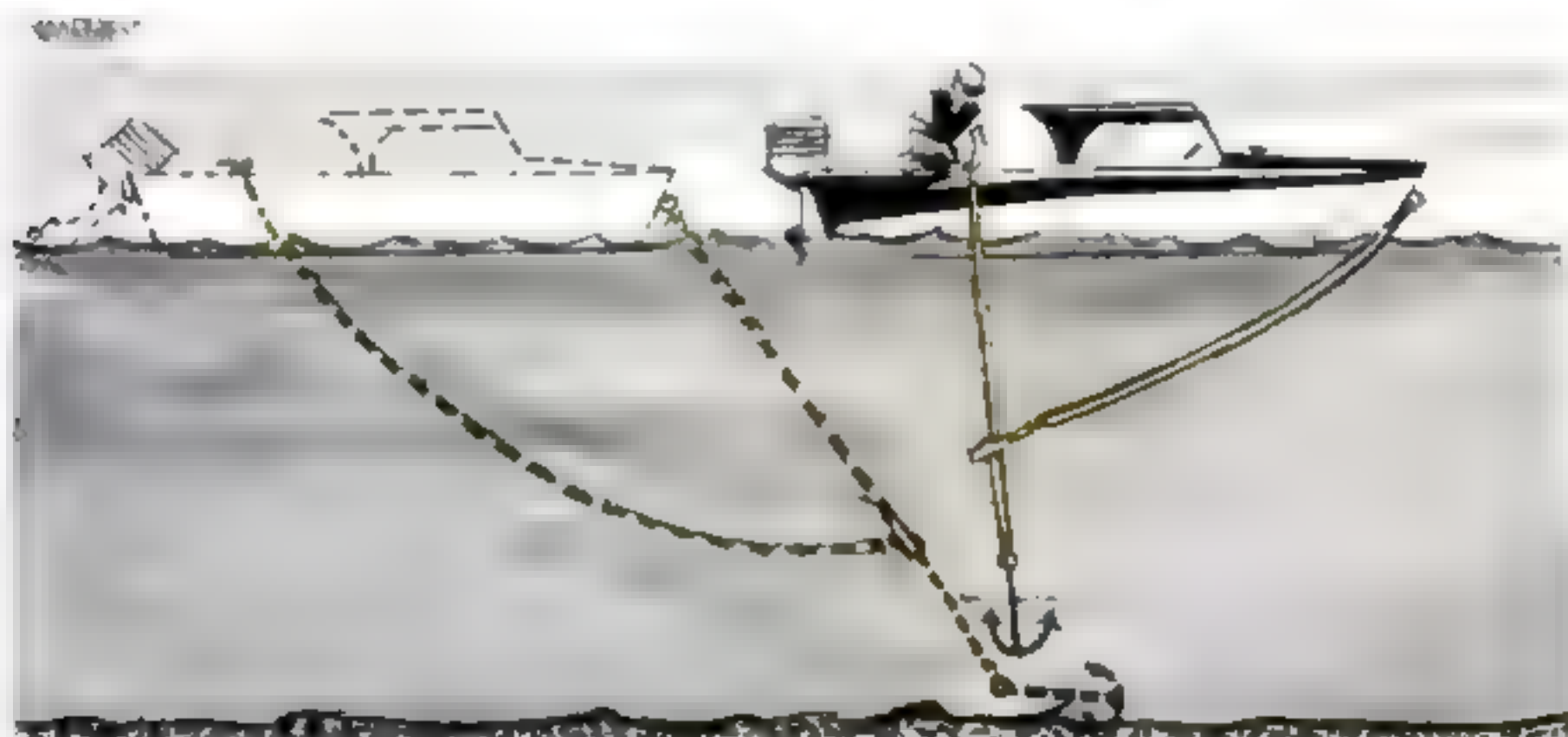
Glasses light your work. Tiny bulbs above the lenses of these spectacles—and batteries in the earpieces—would put light where you want it and let you use both hands. Opaque reflectors behind the bulbs would focus the light and keep it out of your eyes. Switches in the frames would let you use either or both lights.



Suitcase grows with load. Add-on sides that could be carried folded inside this suitcase would let you increase luggage capacity as you needed it. Zipper tracks around the main case would engage tracks on the add-on units. Long loops on the side sections would slip through the main carrying-case handle.



Brake spins tail-light beam. A brake light might flash a more urgent and unmistakable warning if it were housed inside this slotted, motor-driven sleeve. Applying either the foot or hand brake would cause the sleeve to spin and thus give an apparent whirling motion to the light that is bounced rearward by a reflector.



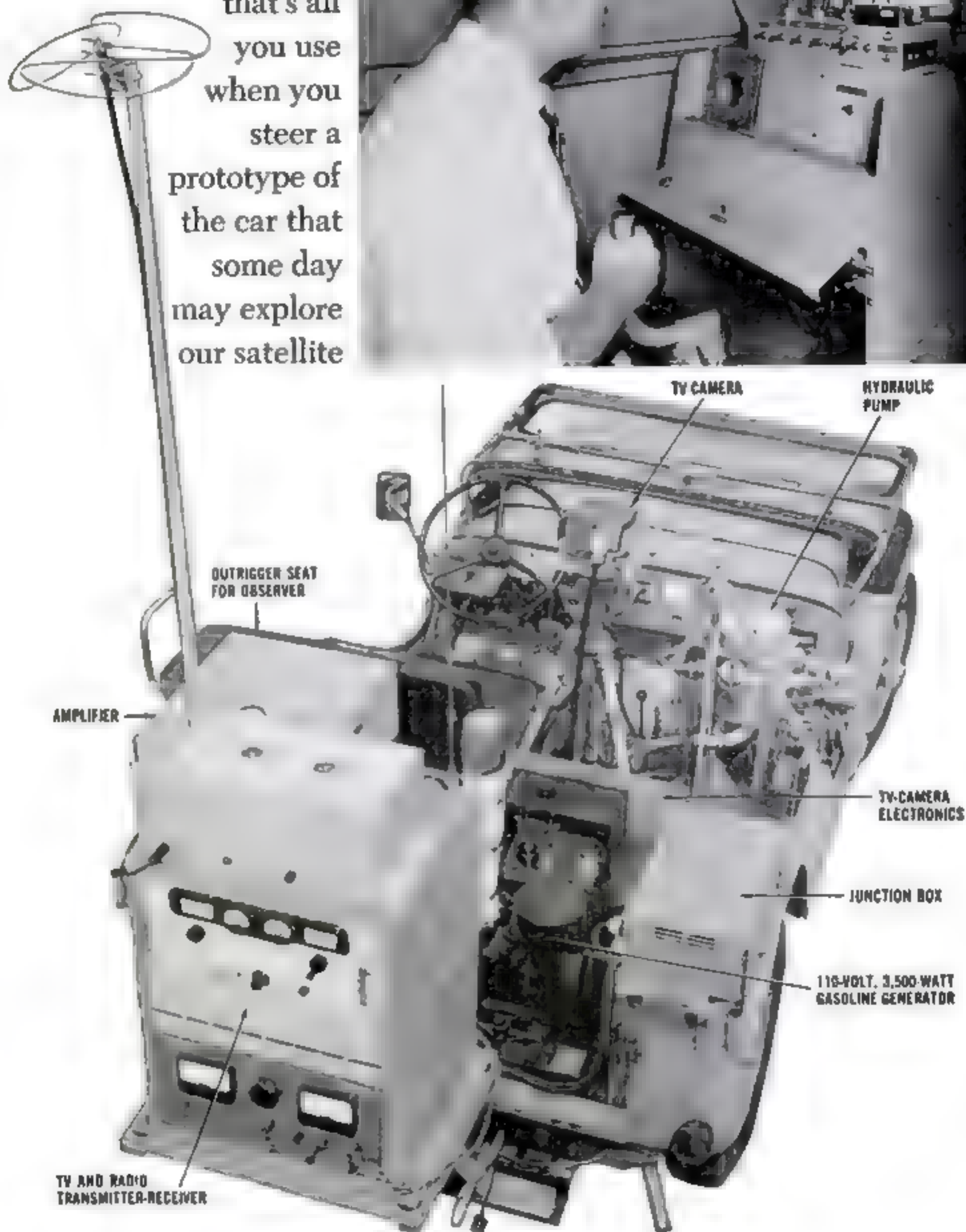
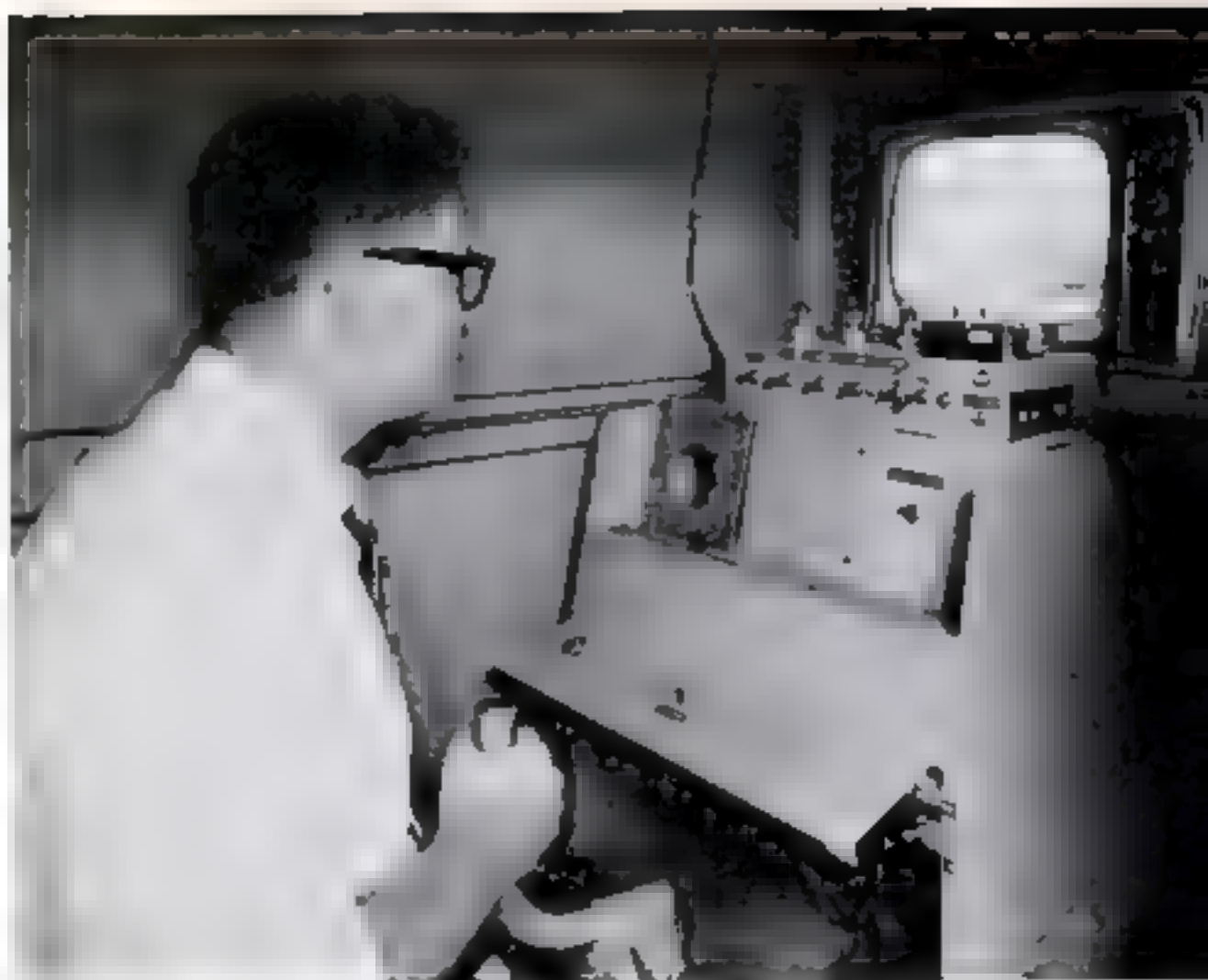
Hitch hauls anchor from stern. You wouldn't have to clamber forward to cast or haul this anchor. Its line would let out from the stern through a Venetian-blind

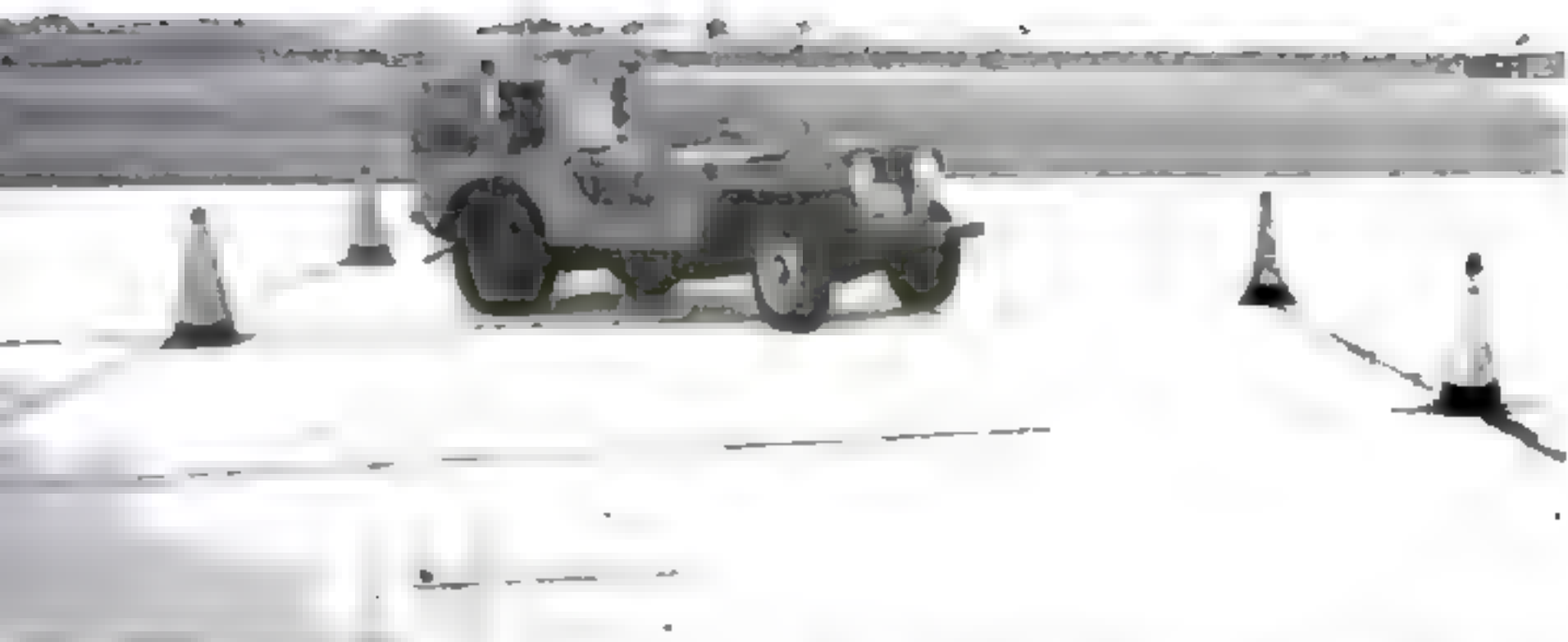
type of one-way slide. A fixed-length bowline tied to the slide would hold the anchored boat in the usual way. To haul anchor, you'd pull forward, then up.

The following patents have been issued on these inventions. Cargo brace—No. 3,062,157 to M. A. Woods, Franklin Park, Ill.; Freezer signal—No. 3,063,235 to P. Winchell, Whitestone, N.Y.; Eyeglass light—No. 3,080,308 to A. J. Fortune, Clinton, Ind.; Add-on luggage—No. 3,081,057 to C. S. Miller, Philadelphia; Spinning brake light—No. 3,054,983 to A. W. can

Oosten, Delft, Netherlands; Two-line anchor—No. 3,062,168 to J. C. Backe, St. Petersburg, Fla.
Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D.C., at 25 cents each. To write to an inventor, if the address given above is insufficient, address him (by name and patent number) in care of the Commissioner of Patents.

A joy stick and closed-circuit TV—that's all you use when you steer a prototype of the car that some day may explore our satellite





Watching a TV monitor to see where the Moon jeep was headed, I steered the vehicle remotely by pushing a hefty control stick to the left or

right. The jeep's route was a twisting 440-foot-long course marked by pairs of rubber cones set 12 feet apart. Lots of room, I figured.

I Drove a Jeep "on the Moon"

By Erik H. Arctander

THE TV screen in front of me cast a dim light in the dark cubicle. I sat on a stool, grasping an aircraft-type control stick in my hand. I was about to steer a jeep I couldn't see or hear over a zigzag course 12 feet wide and 440 feet long.

To make it harder, every change-of-direction signal would be delayed. I'd have to make each steering correction $2\frac{1}{2}$ seconds before I wanted it to take effect.

Why was this weird challenge to human skill devised? Not out of idle curiosity. Grumman Aircraft engineers want to find out how an unmanned vehicle can be guided over the moon's surface by remote control. A TV camera on the

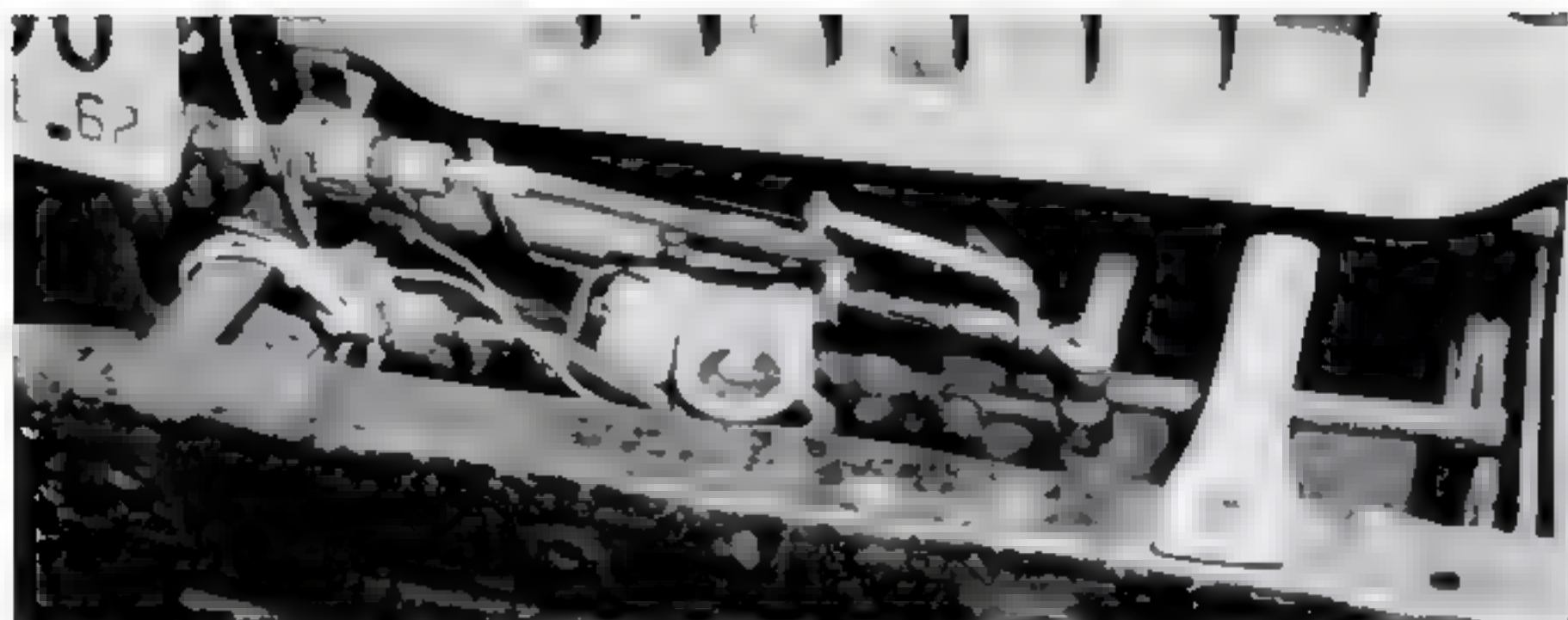
vehicle there would broadcast pictures to earth; from here, a "driver" could send back signals to control the vehicle.

The reason for the time delay on the test apparatus: Radio signals take about $1\frac{1}{4}$ seconds to span 239,000 miles—the average distance of the moon from earth. Round-trip time for a signal to reach the vehicle and for the result to show on the TV monitor is $2\frac{1}{2}$ seconds.

My test run was about to begin. I sat in a blacked-out cubicle—a small trailer on an unused airstrip outside the vast Grumman plant in Bethpage, Long Island.

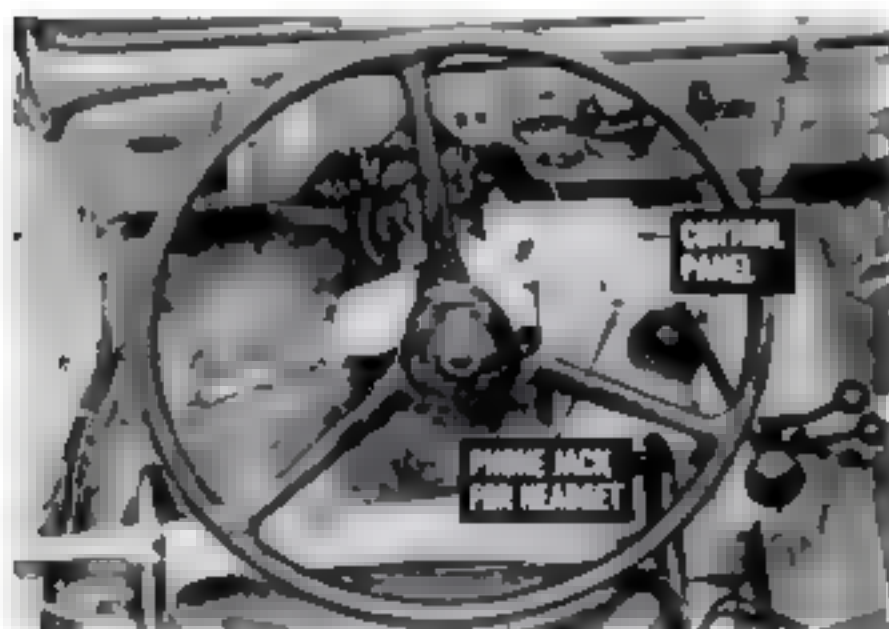
The moon vehicle was a specially altered jeep dubbed Luna-tick 1. The test would be at "high" speed: The governor in the jeep was set for 4.25 m.p.h.

Suddenly two columns of rubber cones



Steering is by a hydraulic cylinder that was originally designed to actuate an airplane wing

flap. A 1,500-p.s.i. pump provides the power; servo motors relay the control signals.



Dash switches allow manual control. Observer in jeep took over when I completed each run.



Governor is set by hand. It permits three constant speeds: 1.4, 3.1, or 4.25 m.p.h.

moved on the TV screen. The jeep had started through the twisting course lined by the cones.

The pair of cones marking the first turn spread apart on the screen. When they were at opposite edges of the screen, I shoved the control stick left against stiff spring pressure, then quickly brought it back. The two nearest cones disappeared off the sides of the screen, but the jeep continued straight ahead.

Just as all seemed lost, the front end of the jeep, visible at the bottom of the screen, swung sharply left.

The next pair of cones was off to the right. I jabbed again at the stick. After an agonizing $2\frac{1}{2}$ seconds, the jeep swung right. Three new pairs of markers lined up on the screen.

It soon became apparent that I hadn't gauged the last turn so well. The jeep was too far right. I scraped past the first

right-hand cone, crushed the second, and went off the "road"—passing on the outside of the third.

I remembered that the course veered left at this point. I shoved the stick hard over and held it there a few seconds. It was sheer guesswork, but $2\frac{1}{2}$ seconds later the jeep swung violently to the left and straightened out smack on the centerline.

The rest of the run went beautifully except for a single miscue that flattened a cone. I was relieved when the run was over; it had been an exhausting 70 seconds.

The hardware: no problems. Russ Hagerman, a project engineer for the Lunar Roving Vehicle, has few doubts about hardware for exploring the moon. Remote-control devices and self-propelled vehicles, he says, are highly de-

[\[Continued on page 178\]](#)



Paraglider "lifeboat" for safe return from orbit

When a man's duty tour in an orbiting space station ends, he'll want to get back to earth safely. Space-General Corp. proposes fitting inflatable glider wings on tubes that would be resistant to re-entry heat.

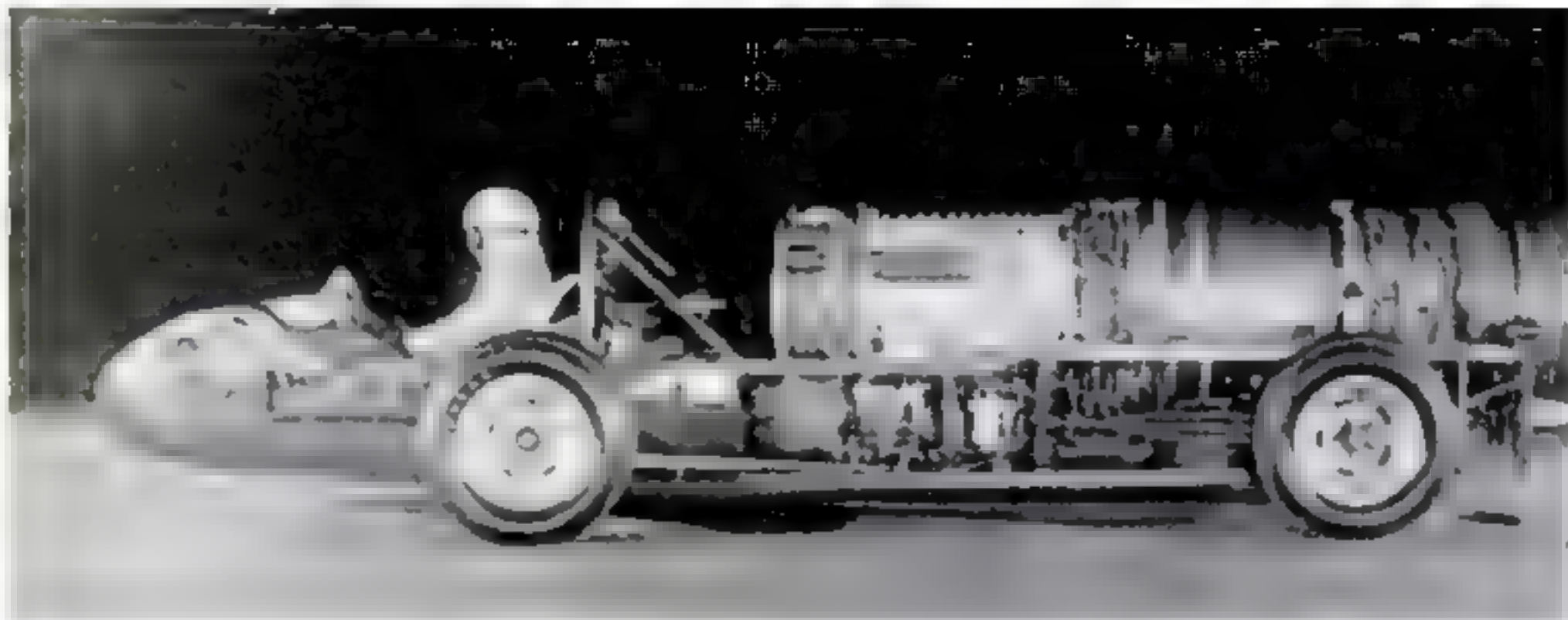
They would be released from the station for return and retrorocketed out of orbit. Two of the one-man space lifeboats are shown above: one gliding towards the earth (left), the other being inflated.

Prehistoric nature trail

The entrance to a unique nature trail displays a map of the route and a sample of exhibits to be found. Along the trail, visitors to the Badlands National Monument in South Dakota see 30-million-year-old fossils of the Oligocene period left in their natural setting but protected by clear-plastic domes. Among them are bones of both extinct mammals and ancestors of some present-day animals.

The trail, off Alt. U.S. 16-A near Norbeck Pass, is a quarter-mile long, takes 20 minutes in an unhurried walk. It was opened to tourists last summer.



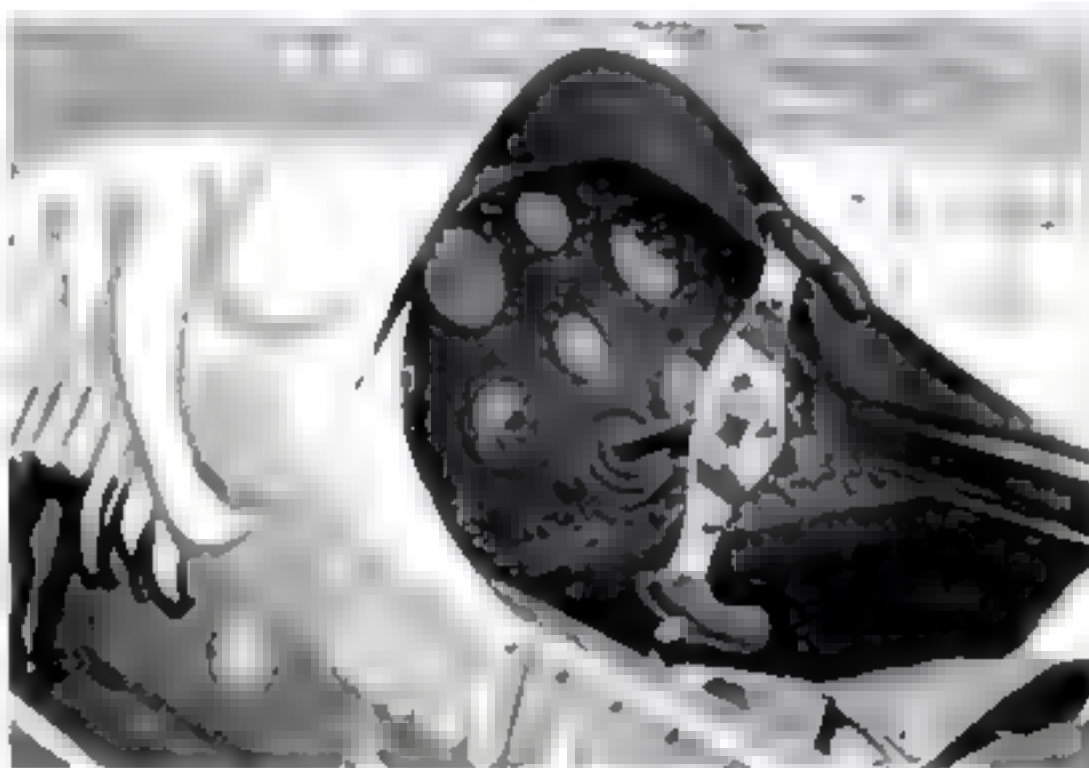


Flame shoots out up to 50 feet, barring races with other cars. Crosswinds make car skittish

Jet car burns up the drag strips

A high-pitched whine, a loud roar, and this jet dragster has covered a quarter-mile—just seven seconds after leaving the starting line. Speed: 240 m.p.h.

Walter Arfons of Akron powers his Green Monster with a Westinghouse J-46 turbojet that delivers 6,000 pounds of thrust—about 7,000 hp. A governor keeps it at half throttle, wide open, the car could do 325 m.p.h., Arfons believes.



Dash houses 10 gauges, including tachometer, ammeter, and exhaust-temperature and power-brake-pressure gauges. Steering "wheel" is a cutaway competition model for dragging.

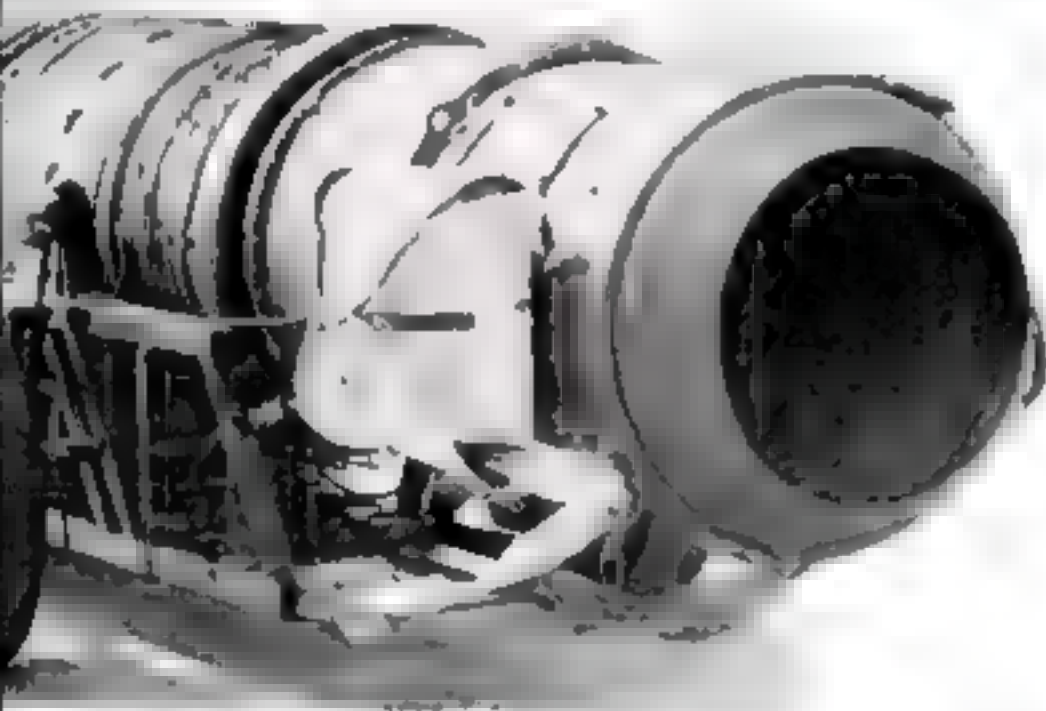


Slot-machine dining adds automation to railroad

Automats on wheels supply quick-lunch service to coach passengers on Southern Pacific trains. They are converted sleeping cars, with tables and chairs at the ends and banks of coin-operated food-vending machines in the center. They operate on a 24-hour basis.

Sample menus and prices: soups and salads, 30 cents; sandwiches, 50 cents; hot plates, 85 cents; fruit juices, 25 cents; rolls and cereals, 15 cents; pie and cake, 25 cents; ice cream, 15 cents; coffee, tea, and milk, 15 cents.

at high speeds, so wind is checked beforehand.



Business end of tailpipe carries a 16-foot aircraft parachute on either side to help stop the 3,000-pound dragster at end of run. Independent suspension gives good handling

Floating lawn mower chops water hyacinths

Flowers are cultivated for beauty by many a gardener, but to Warren G. Grimes they're a nuisance—when they are water hyacinths choking the lake around his Delray Beach, Fla., island home

To control the water pest, he rigged up a chopper on an outboard pontoon boat. It consists of 50 knives on a rotor chain-driven by a four cylinder tractor engine. It cuts the plants to bits four inches below the surface.



Photofloods on vending machine

Shutterbug tourists will find the West German city of Brunswick a photographer's paradise. For their convenience, the front of St. Catherine's Church lights up at night—with the deposit of 50 pfennigs (13 cents) in a box in front that looks like a parking meter. The floodlights it controls provide illumination long enough for several shots.

A personal-use report on the Heath Hi-Fi TV Kit

By Hubert Luckett

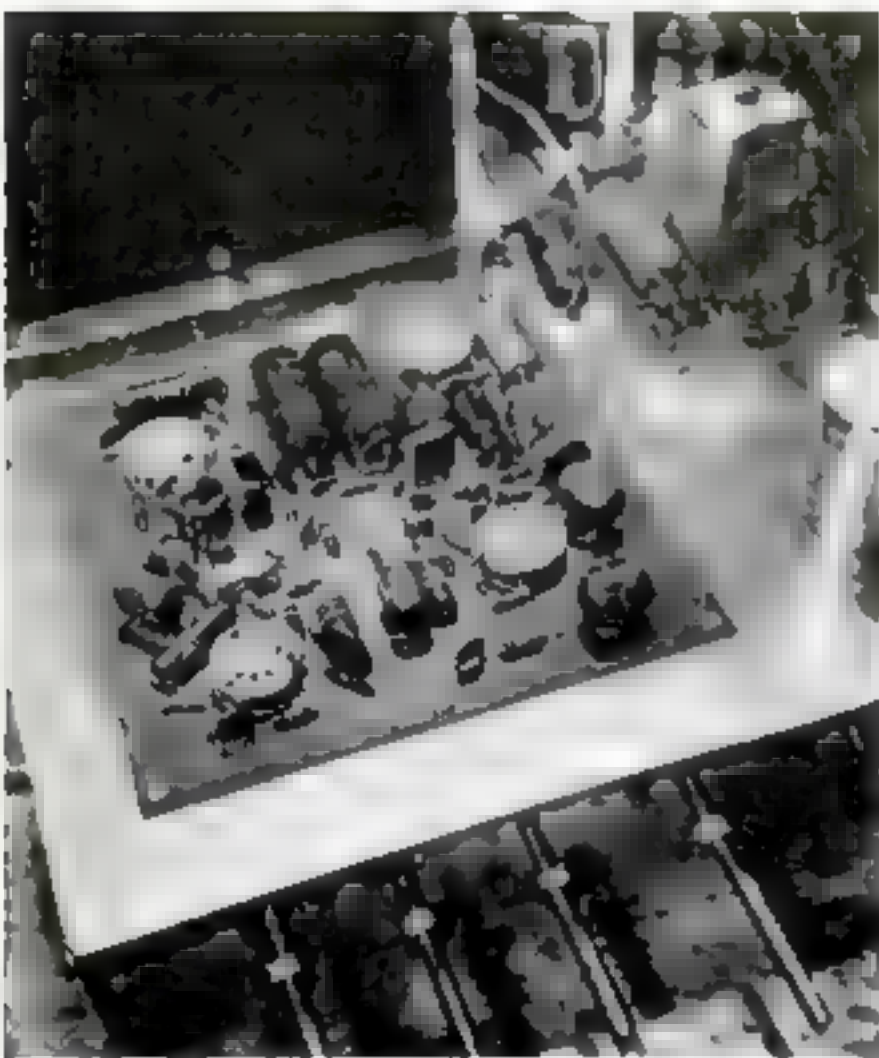
"I'VE never seen a TV picture like that. It looks like a fine photo enlargement. What's the trick?" My friend was talking about the picture on a TV set sitting on my workbench. A few hours before—13 working hours to be exact—that same set had been a paper bag full of parts plus a few subassemblies.

With this kit, the Heath Company has made an all-out effort to provide a TV receiver that will play in the same quality league as hi-fi sound systems. They have succeeded. There are no tricks, no new inventions or scientific breakthroughs. But the picture is markedly superior to the one most people watch on ready-made sets.

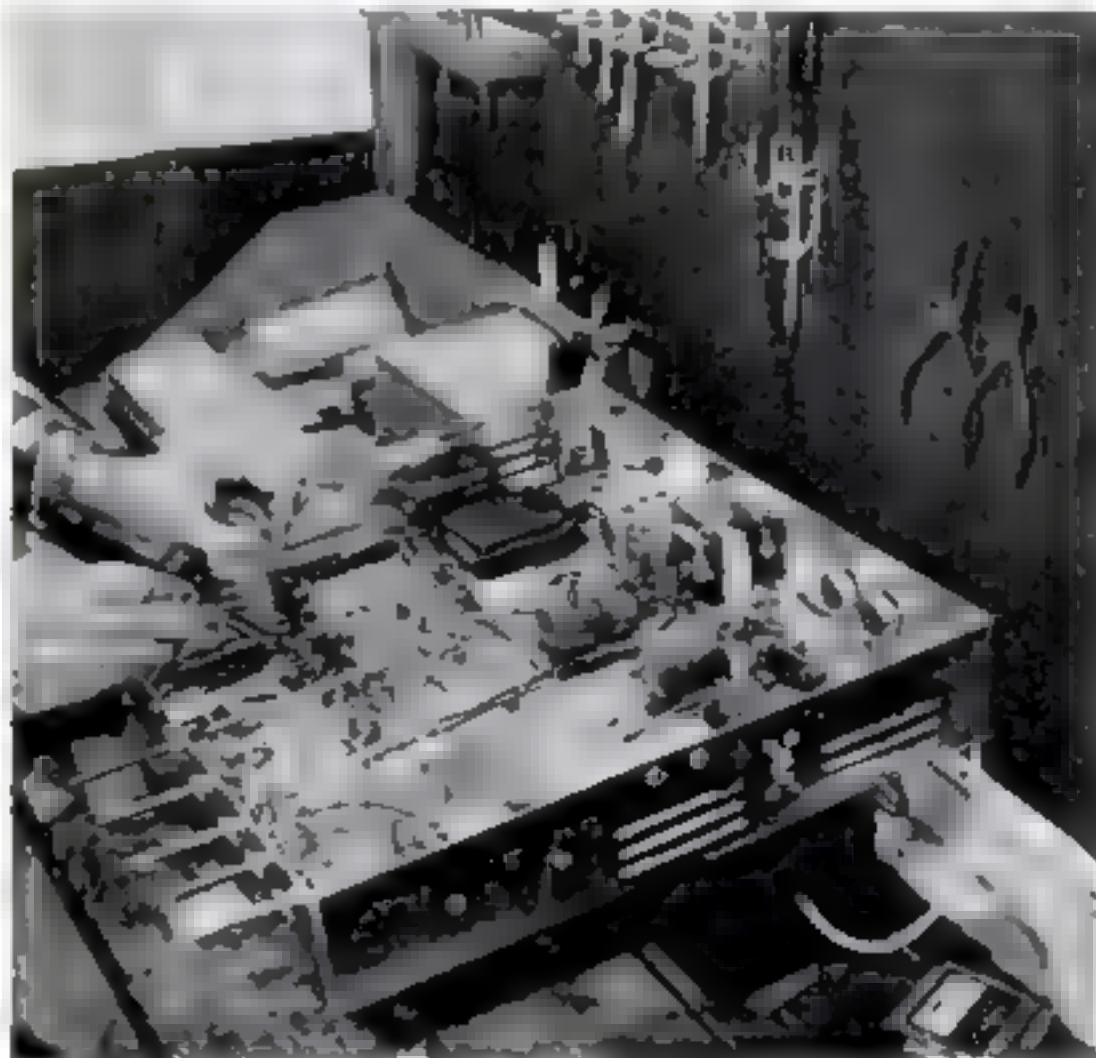
How did they do it? By conscientious application of know-how familiar to any good TV-engineer—no penny-pinching on circuitry, no compromise with performance to get a slimmer box.

The Heathkit 23" Custom TV kit sells by mail order for \$169.95. A wall-mounting mask and panel kit is available for \$25.95, or a furniture-style cabinet for \$89.95.

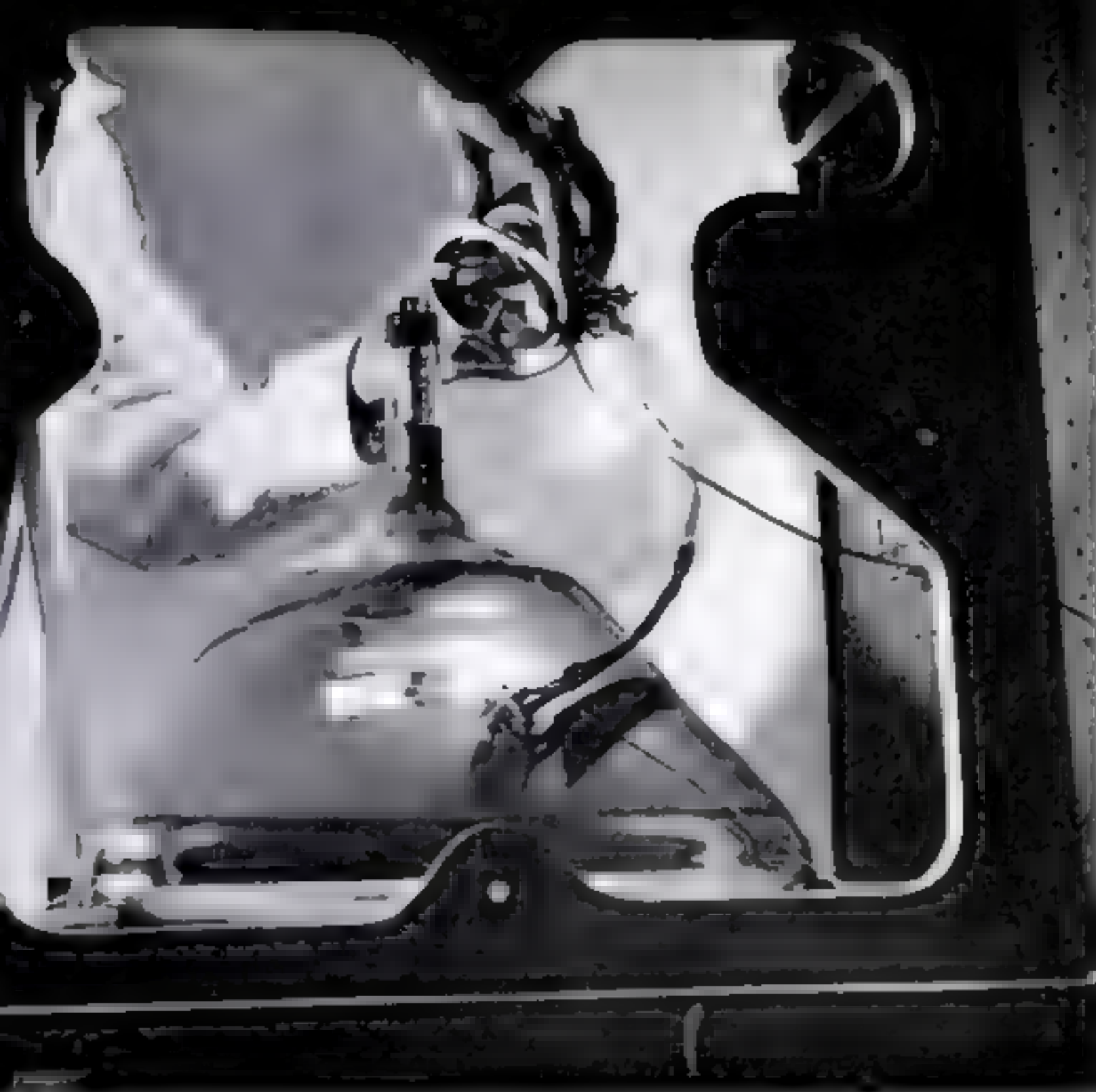
Two sound outputs are provided: One delivers two watts of clean, low-distortion sound to any external 8-ohm speaker; the other, a special output (cathode follower), plugs into your hi-fi.



Printed circuit boards save construction time and prevent wiring mistakes. You assemble the one shown here. It contains the sweep circuits and part of the audio amplifier. Two other subassemblies—IF amplifiers and high-voltage section—are factory-wired. All critical circuits are aligned and tested at the factory.



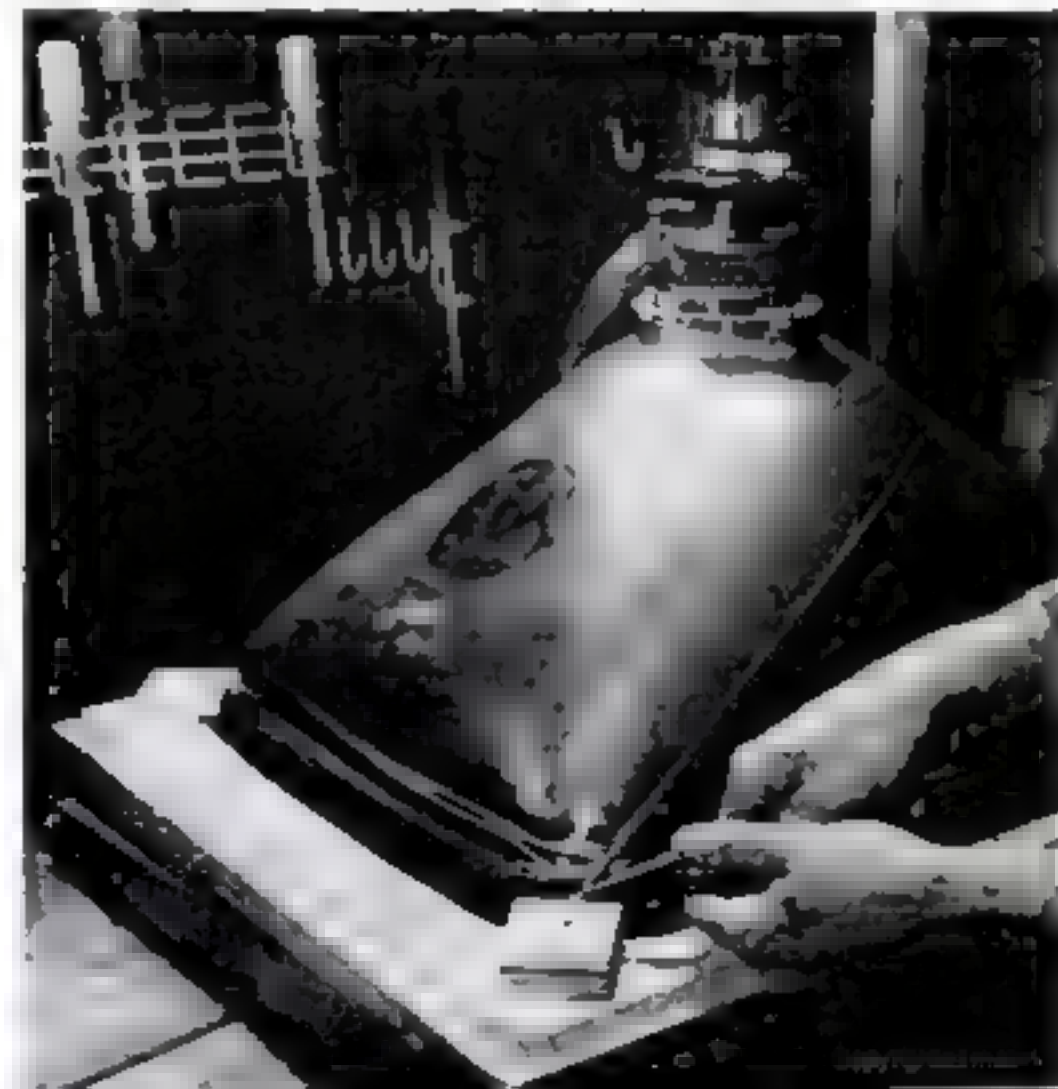
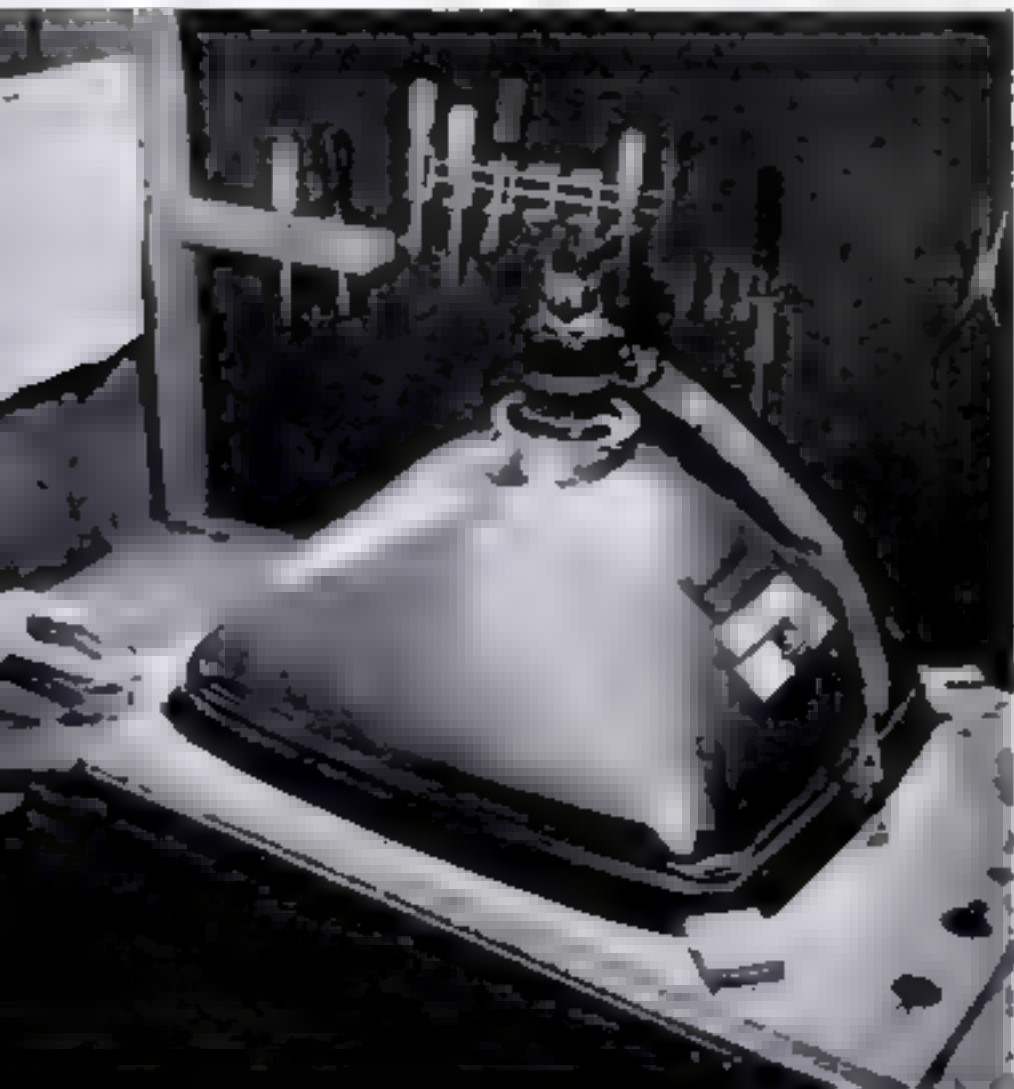
Most of the interconnections between subassemblies are made with two prefab wiring harnesses. You simply solder the proper colored wire to labeled terminals. A few individual resistors and capacitors must be soldered to terminal strips, but the chassis is roomy and wide open—there's plenty of room to work.

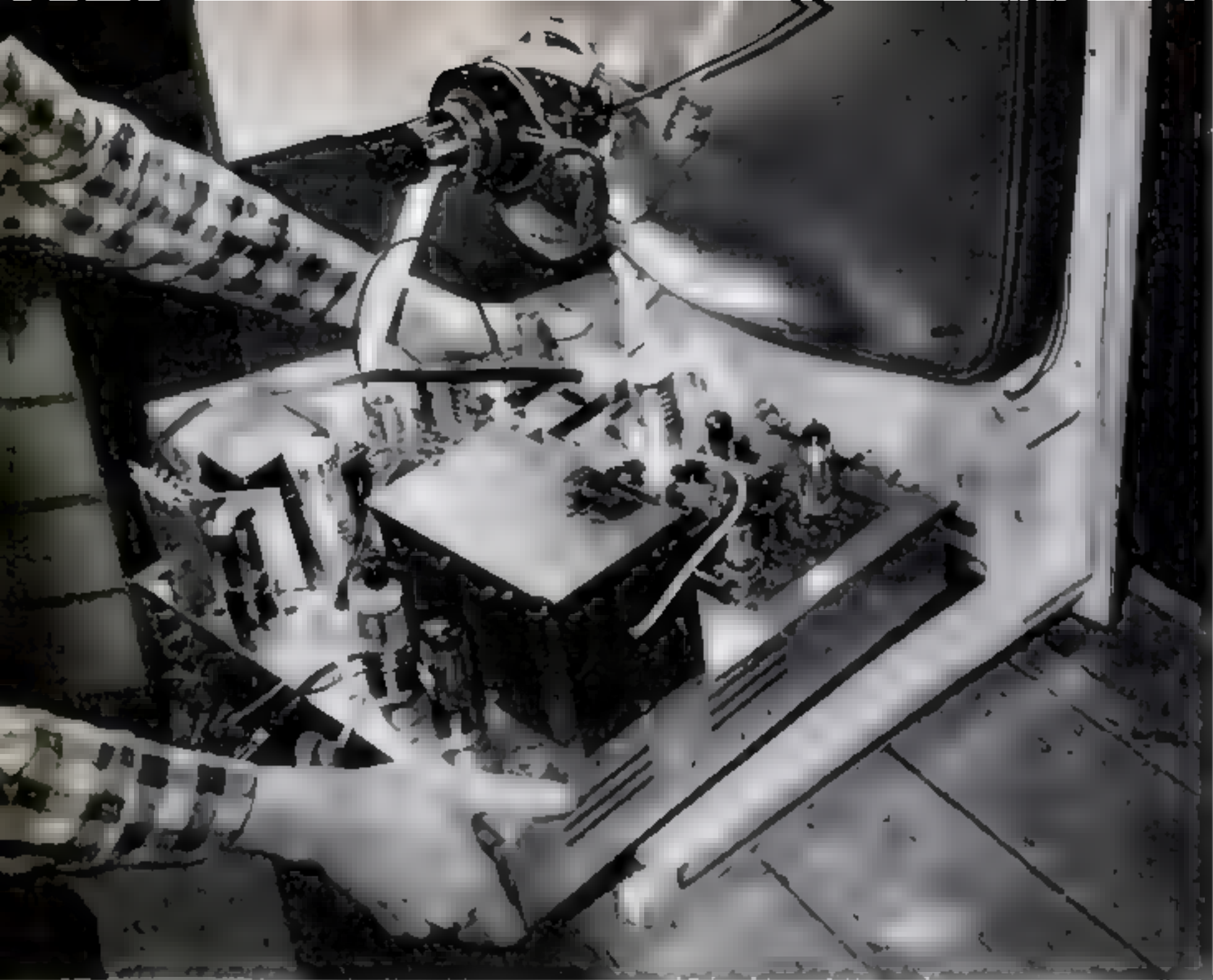


Here the yoke is being placed on the neck of the picture tube. Photo was taken through the opening in the vertical chassis-mounting board—shown attached to the front panel of the wall mount. Separate mounting of the chassis is also possible.

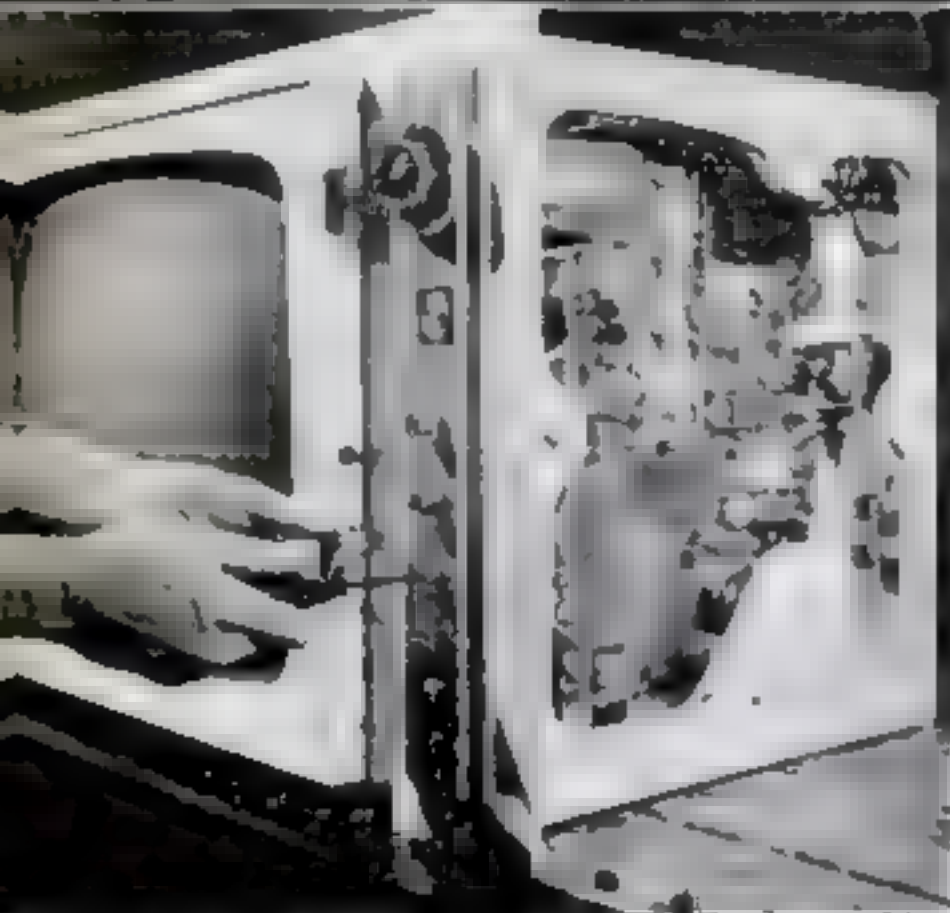
Picture tube is 90-degree-deflection, high-definition type with anti-glare bonded safety glass. Integral molded ears at each corner simplify mounting to front panel. Hardwood mounting blocks supplied with the kit are screwed to the panel to clamp ears. No other mounting brackets or supports are needed.

Picture-tube outer coating is grounded by a bare wire stretched diagonally across the tube; a spring attached to one end holds the wire tightly against the coating. Deflection yoke fits snugly on the bell of the tube and is held in place by a single screw clamp. Leads plug into chassis socket. **CONTINUED**



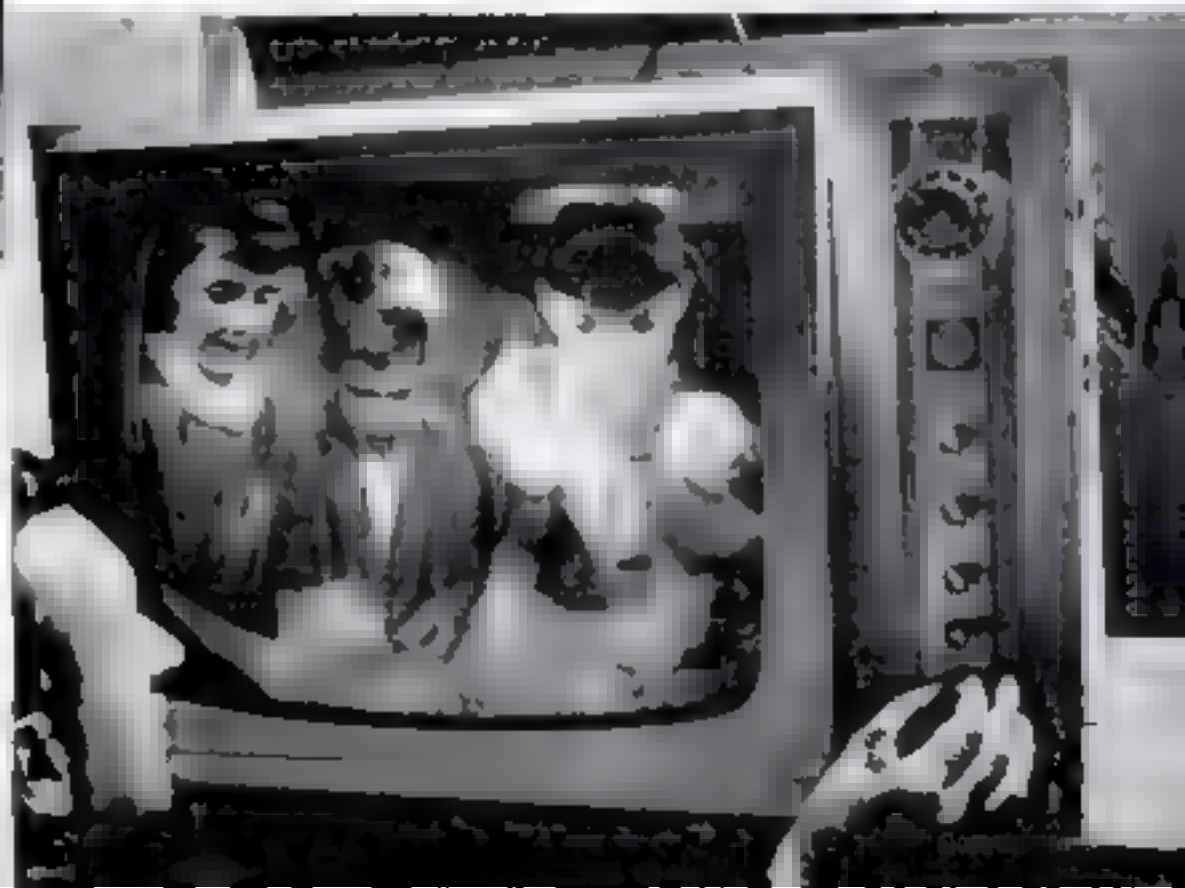


With picture tube securely mounted, panel is up-ended to install chassis. All control shafts project through holes in the front panel. Chassis is held by four bolts that run through the mounting board into captive nuts on the chassis.



Completed set left worked fine. Only adjustment needed was of operating and service controls to get a good picture. Height, linearity, and AGC controls are reached through hollow shafts on the operating controls.

One reason for the superior picture is the complete complement of adjustments provided and detailed instructions for finding the best setting for each. Some adjustments are usually omitted on commercial sets, and a TV repairman seldom takes the time to make the best use of those that are provided. ■ ■



HOW TO BUILD A Kabob Rack for Your Barbecue

CHARCOAL-broiling shish kabob often results in scorched meat, raw vegetables, and frayed nerves. Prevent this by making a 12"-by-13" aluminum framework, notched to hold four skewers on which the food is spiked. It supports a kabob load the right height from the coals.

Take a piece of scrap aluminum 25½" long and 5" wide. Bend a ½" right-angle lip along each long side. Then cut the strip lengthwise into two equal pieces. Notch a 90-degree angle in each lip, 12" from one end, to make the bend. At one end of each piece, cut a ¾" square from the lip. The portion of strip above this can then be lapped over for riveting. File rough edges smooth. Complete the frame by cutting four notches in each 12" leg of the rack.

Using square skewers will help to keep the food from sliding around and cooking only on one side.



1 Bend a ½" lip along each side of metal strip. Easiest way to do it: Tap strip over edge of bench. Now cut strip lengthwise. Result is two long strips, each with a lip at side.



2 Bend strips at right angle, 12" from end, to produce mating parts. Before bending make 90-degree V cut in lip of each strip at bending point. Cut ¾" square from lip at 13½" end.



3 Drill or punch holes for rivets, making sure bottom edges are flush so rack sits squarely on grill. Rivet the two sections together and peen ends on a flat metal surface.

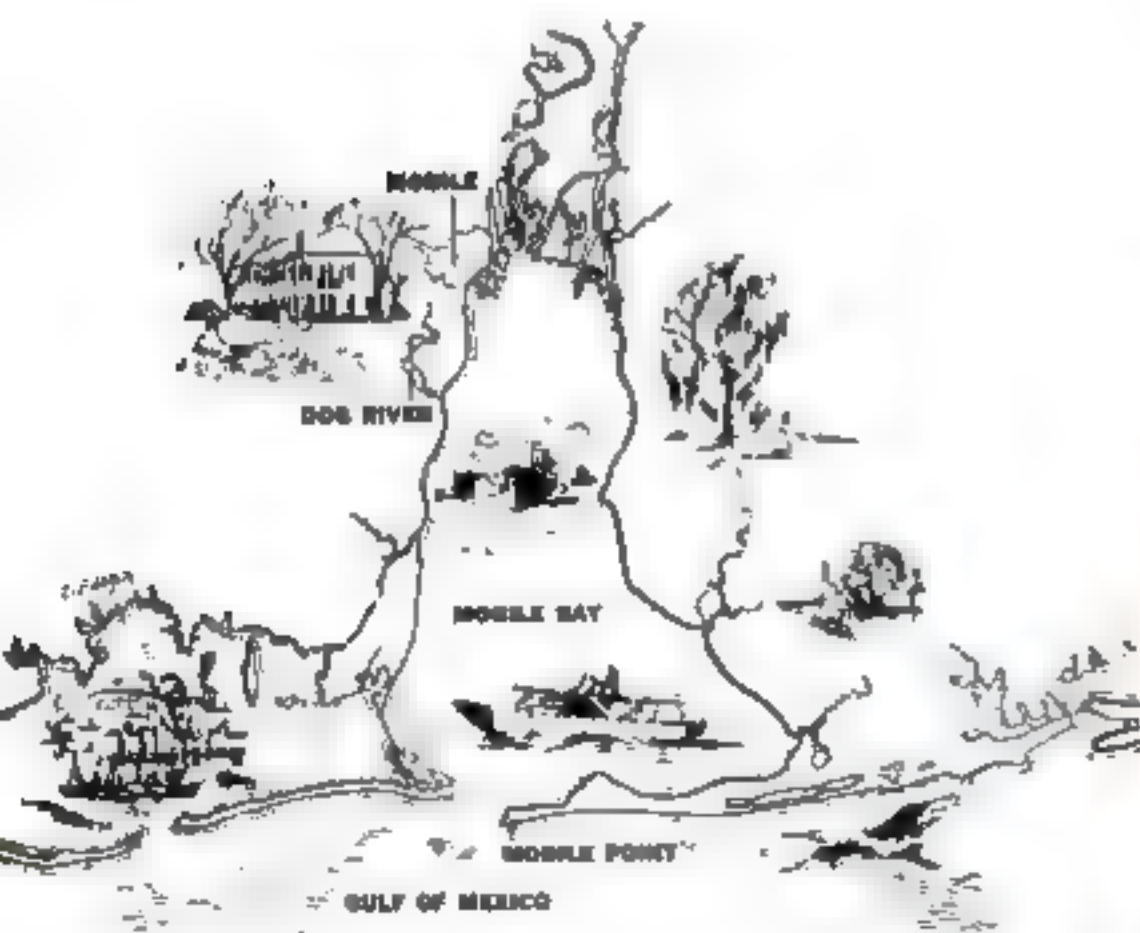


4 Finish by notching four slots on opposite sides of 12" sections. These should be about 2½" apart. Allow 1" clearance for meat at sides. Bend down notched sections with pliers.

Jim Roe Tests the Lone Star Cruise Liner II

By Jim Roe

PHOTOS BY TONY MAXWELL,
THIOPH NLDHUS



Mobile Bay was site for this Gulf Coast test. It offers a good combination of interesting, protected rivers, shallow bay waters, islands, Intracoastal Waterway, and open Gulf waters.



MOBILE, ALA.

MOST boat and motor test runs are made under cloudless skies, with conditions just right for boat, motor, skipper, and photographer.

This one wasn't that way.

When we cleared Dog River light into Mobile Bay, we were in the middle of a good, honest January rain-storm. Parkas were the order of the

The power: Two brand-new Johnson 75-hp. Electramatics. Each was equipped with an alternator, located beneath my left hand. They gave us speeds that topped 35 m.p.h.





day. New Orleans airport FAA radio promised nothing but more of the same, with an interesting frontal pattern to boot.

But no matter. One of the things I like to pass along to POPULAR SCIENCE boatman-readers is just how boats and equipment operate when conditions are not ideal.

We were anxious to get at the job, for this was an interesting combination. The

This is shrimp-boat country. Small, sturdy craft like the one at right ply these Gulf waters for shrimp and oysters. When the catch is good they return to port with gunwales awash.



boat: Lone Star's new Cruise Liner II, a 24-foot aluminum lapstrake outboard cruiser. The motors: twin 75-hp. alternator-equipped Johnson Electramatics.

We chose the boat for a very special reason. Most boats, when offered for sale, resemble shell houses. Any finishing is up to the boatman himself—both to build the conveniences in, and even to design them. This slows a fellow down. The result, too often, is that he either doesn't get the boat at all because he doesn't see how well it *could* be outfitted, or he does buy it and gets tired of

CONTINUED

What we're testing

The boat: Lone Star's Cruise Liner II

Specifications: Length—24 feet
Beam—96 inches
Weight—1,450 pounds
Capacity—3,218 pounds
Max. hp. rating—150

Price: \$2,795.

Motors: Johnson 75-hp. alternator-equipped Electramatics. Price: \$1,065 each.

Rigged by: McLeod Marine, Mobile, Ala.

"boating" before he ever leaves the dock.

Now, however, a small but growing number of look-ahead manufacturers are designing and building into their boats a great number of conveniences right at the factory. Lone Star's Cruise Liner II, when we first saw her at the Chicago trade show, seemed an outstanding example of this new breed of boat that's ready to use when you buy it.

Just take a look, as we head for the middle reach of the Mobile Ship Channel, at what those folks down in Dallas, Tex., have designed and built into this 24-foot hull.

One of the most obvious new features—and one of the most useful—is a big walk-through bow hatch. To open it, you release the center section of the cabin windshield, lower it, and slide it forward, far up under the bow deck. Then a big hatch section of the bow deck slides forward too. The result is that you can literally walk, not crawl, right from cabin to bow.

Standing room. After you've thoroughly examined this new hatch, you'll discover that all of this time you've been *standing up* inside the cabin of a 24-foot outboard cruiser. This, too, is different. The 70-inch headroom allows all but six-footers to stand up straight.

So, what else is new?

Several things. Among them, the ingenious method of slinging roll-up top bunks. These are made of stout fabric attached to the gunwale side of the cabin over each regular lower bunk, with a tubular aluminum support rod sewn into the inboard side. When not in use, these simply roll up on the rod and rest unobtrusively in the stowage compartments on each side of the cabin. To use them and transform the boat into a four-sleeper, you simply unroll them toward the center of the cabin and hook the tubular rod into handy supports.

Lone Star engineers have made every inch count. A good example is the marine head, always a vexing problem in an outboard cruiser. If you install a fully enclosed head, it takes a big chunk of the cabin area.

Heavy-weather test proves value



It was raining as we left the dock, and New Orleans FAA radio promised more. For safety, we kept track of upcoming weather on the Zenth Royal Navigator through earphones. Special panel area test controls.



Lots of storage room. Here the extra gear and bunks are stowed. Handy shelves. There's other storage for bunks in bow, under pilot platform and under motor well. Total storage in the boat adds up to some 50 cubic feet.

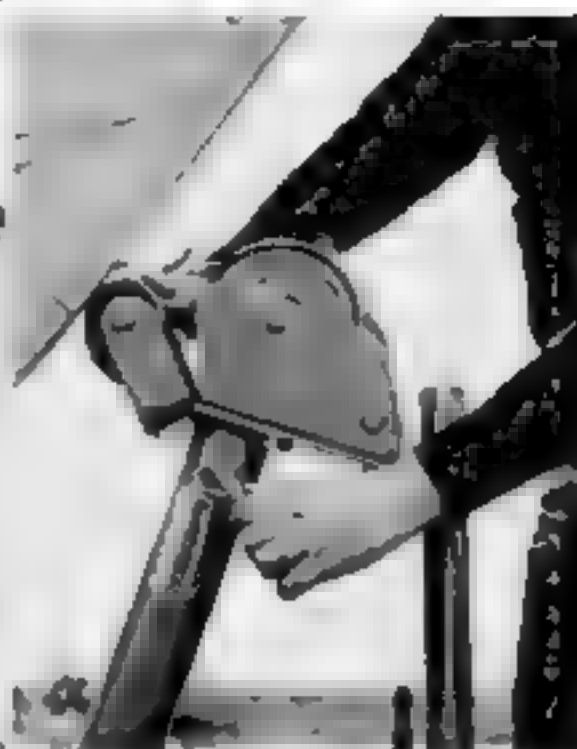
So here's a slick way of eating your cake and having it, too. A marine head is installed just forward of the cabin bulkhead on the starboard side. A permanent bulkhead separates it from the rest of the cabin, *up to about work-table height*, where it is hinged. It folds toward the stern and rests, horizontally, against the rear cabin bulkhead. In this position it completely conceals the head and leaves the cabin area looking large and uncluttered.

When you wish to use the head, all you do is swing this hinged bulkhead to

of Cruise Liner II's many built-in features



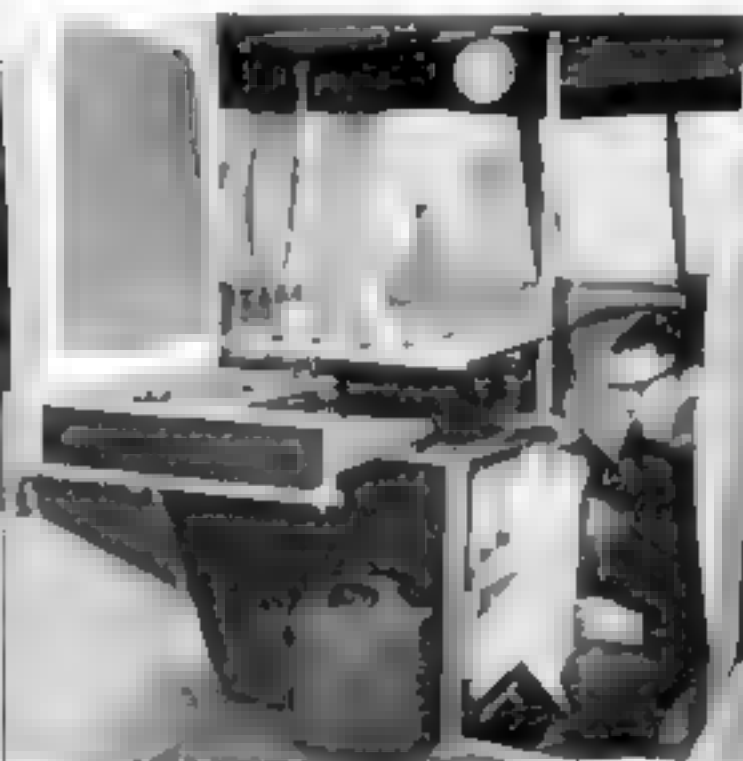
Running lights on Cruise Liner II are built into hull itself. Hull is lapstrake design, formed of corrosion-resistant aluminum on a large forming press.



Telescoping winch lets you adjust height for best angle of pull. Launching and recovery were easy, even by hand. A power winch would help.



Walk-through bow hatch proves its worth as we approach dock. Here Earl Glenn heaves line while standing securely in the boat—a valuable safety feature.



Well-designed galley has stove that swings out with cabin bulkhead. Icebox, water jug stow below, dishes above. Head-room allows stand-up cooking.



Enclosed head is separated from cabin by swing-out bulkhead that folds horizontal for more room. Curtain hides head or swings to form dressing room.



Cabin sleeps four. Top bunks roll up into shelves when not in use. To rig, you hook aluminum rails in brackets. This makes craft a fine family boat.

a vertical position. A sliding curtain acts as a door.

Equipment plus. The Cruise Liner II also comes equipped with a swing-out, fully equipped galley. This is attached to the port-cabin bulkhead. Unlatch this bulkhead and swing it toward the stern, and you're in business. A marine two-burner alcohol stove is attached to the bulkhead itself, and has a small work space in front of it. It swings out from under a plastic-topped workbench inside the cabin area, so you produce a stove and two work spaces just by swing-

ing the bulkhead. Beneath the inner work space is an ice refrigerator. Beside it is storage space for a 2½-gallon plastic water jug, a big plastic dishpan, and a set of plastic tray-plates. Plastic cups and tumblers are stored above the work area. All are standard equipment.

This boat even has a private dressing room. Swinging curtains at the rear of the cabin fit into handy brackets to form a completely enclosed space for dressing. There's also a mirror—standard equipment, of course.

Besides all these ingenious built-ins,

the cabin has two ready-installed storage racks running the length of the bunks, and storage under the bunks themselves—for a total of 50 cubic feet of storage space. All the windshields are safety glass, and the cabin roof and cockpit are foam-lined. This helps deaden noise and provides flotation. In fact, the Cruise Liner II has enough punctureproof foam flotation to support more than its OBC (Outboard Boating Club) rated capacity.

There is no brightwork on the Cruise Liner II. Textured vinyl serves as trim along the cabin overhead line and for the bulkhead coverings. Cabin and cockpit floors are covered with vinyl. As a result, the craft needs little or no maintenance or polishing. A mop and a bucket of water keep her shining.

In the cockpit. The boat comes complete with mechanical steering, pilot seat and platform, and running lights wired to switches. The motor well is watertight, and has a plastic-fabric curtain that fits snugly to the cockpit floor, covering up the usual clutter of wires, batteries, gas lines, and other whatnottery.

Lifting rings are affixed to the deck and to the transom. Aluminum construction makes the boat light enough for its size so that most outboard hoists can handle it without slings.

This same weight advantage makes the boat equally easy to launch from and recover on a trailer. We trailed it to the water on Lone Star's specially designed trailer, and it took only moments to put it in and get it back out of the water. Even with a hand winch, recovery was not difficult. A power winch would have made it a cinch.

Trailing this boat, even though it's 24 feet long, is easy. Its beam width is just 96 inches, which quiets the fears of patrolmen and tollgate attendants. Though the boat weighs but 1,450 pounds, it's OBC-rated to carry 3,218 pounds, including, of course, engines, fuel, gear, and passengers. Maximum horsepower rating is 150.

And 150 horses are what we based our test on. Although the two Johnson V-75 Electramatics were brand-new and not run in, they were "in all respects ready for

[Continued on page 184]

Here's how Lone Star builds Cruise Liner II for safety and long life

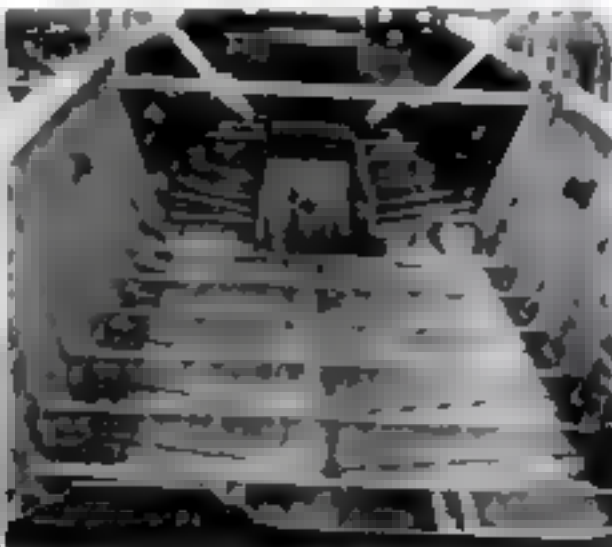
For all normal conditions, this boat is a rugged, well-put-together craft. As a matter of fact, it's so well put together that its makers back it with a guarantee that says, among other things: "Lone Star aluminum boats in noncommercial usage are warranted for the life of the original owner against

skin punctures and popped rivets. . . ."

That's quite a promise. The manufacturer's guarantee also includes one-year warranties against defects in workmanship or materials and against trailer damage if the boat is hauled on a properly fitted, specified Lone Star trailer.



Bulkheads and hull plates are assembled on a master jig to insure accurate hull configuration. Strakes add stiffness.



Close-spaced bulkheads, formed on 1,000-ton press, give the hull high strength. Aluminum keeps boat light.



Styrofoam blocks, inserted between bulkheads and in cabin roof, provide flotation, noise damping, and insulation.



Make the hone from $\frac{1}{4}$ " tempered hardboard, glued screen-side-out to $\frac{3}{8}$ " plywood. Before gluing, saw the center hole in the hardboard large enough to countersink the arbor flange.



Mount the hone on a high-speed spindle grinder, lathe, drill press, or circular saw. Sand edge smooth. Make sure the hole in the center is square with the disk's face.

Lap-Honing Makes Edges Supersharpen

PS SHOP

HERE'S an idea borrowed from diamond cutters, who use flat laps charged with fine abrasive to facet gemstones. Rig a hard-faced disk on a high-speed spindle, charge it with buffing compound—and you'll have a lap hone that, after you've finished conventional sharpening, will put an extraordinary final polish on a chisel, lathe tool, or other beveled blade.

The lap shown is simply an 8" diameter disk cut from scrap $\frac{3}{8}$ "-plywood faced with $\frac{1}{4}$ " tempered hardboard, glued on screen side-out. The patterned screen indentations will load and hold buffing compound. White rouge works best.

When the disk is mounted on any fairly high-speed power-tool spindle, it will quickly polish a flat tool bevel and superfinish the tool's cutting edge. For best results when honing a beveled blade, hold the cutting edge against the disk so that the hone revolves across the bevel. Always angle the edge in the direction of the disk's rotation to keep the tool from slicing into and scoring the hardboard.



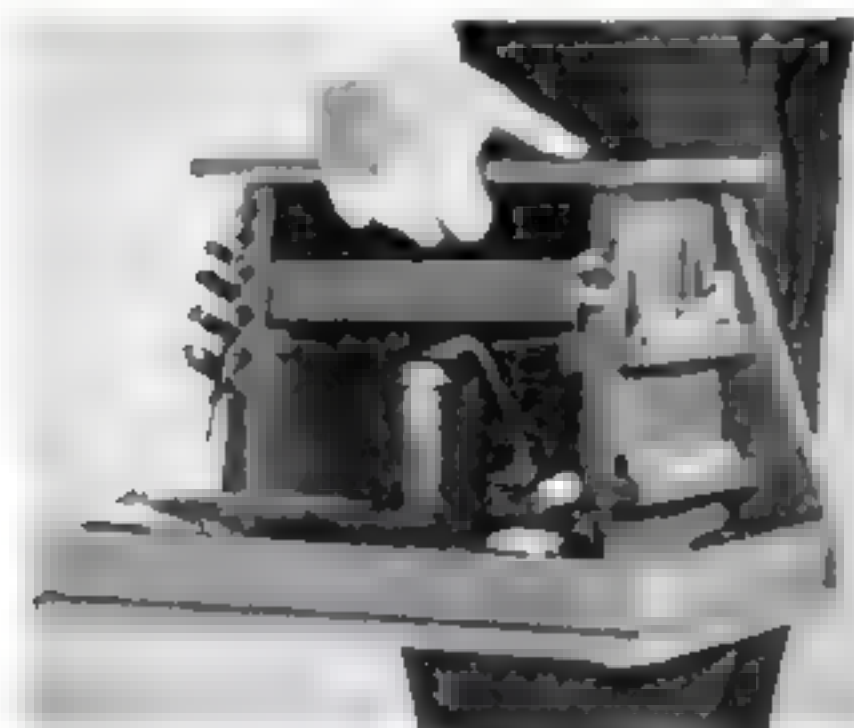
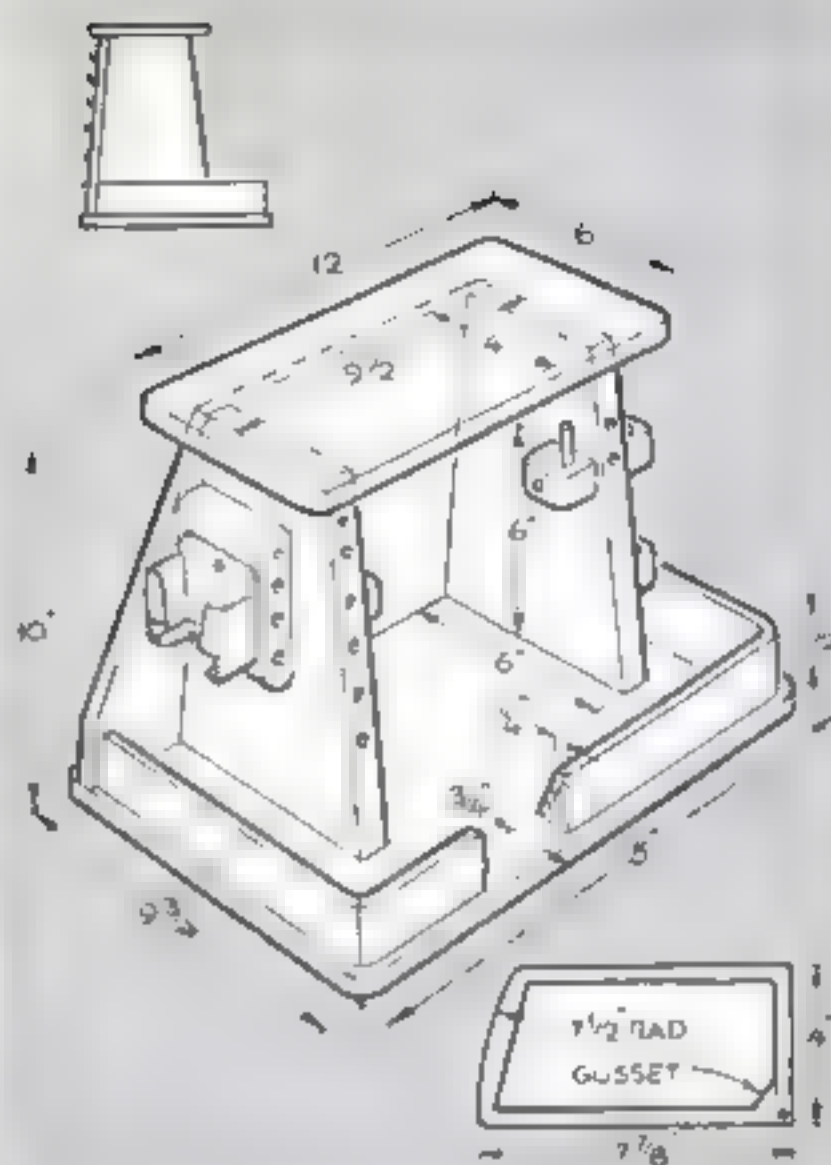
To charge the wheel for buffing, hold a stick of white rouge, or other buffing compound, lightly against the face of the revolving disk. Waffle texture of the hardboard holds the compound.

Jeweler's eye loupe is a great help for disk-honing edged tools. An inexpensive loupe that magnifies three or four diameters lets you see exactly what results you're getting.

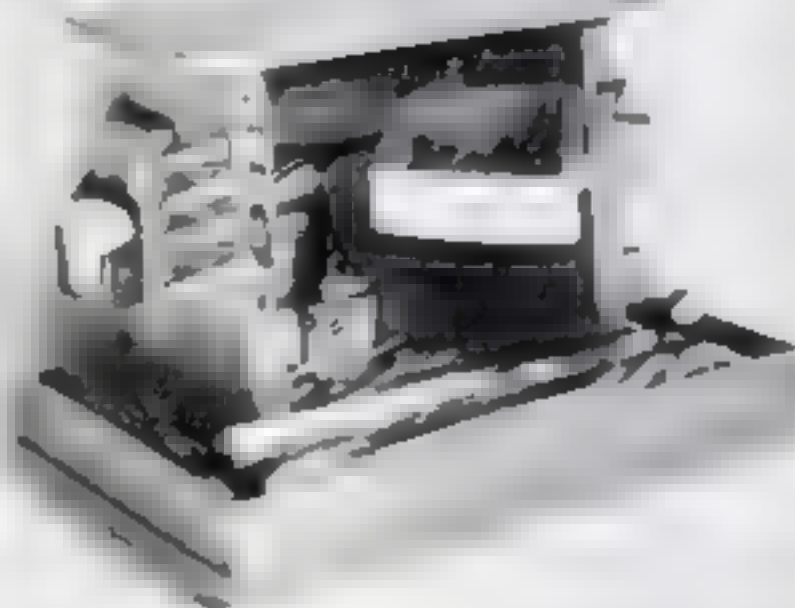




You can sit on this tool stool for low jobs like repairing a power mower. For the stool shown $\frac{3}{8}$ " plywood was used for the base, seat, and back, $\frac{3}{4}$ " pine for the two vertical supports. Tapered side rails were ripped from $\frac{3}{4}$ "-by-1 $\frac{1}{2}$ " pine. All corners are sanded round.



A swing-out tray stays inside when you carry the stool. It has a $\frac{1}{2}$ "-hardboard bottom. The sides and one end are $\frac{3}{4}$ "-by- $\frac{3}{4}$ " pine; the curved



end was made from $\frac{3}{4}$ " pine, cut to a $7\frac{1}{2}$ " radius after assembly. The hinge pin, a 2" length of $\frac{3}{16}$ " steel rod, fits snugly in its block.

A Tool Holder That Takes You off Your Feet

THIS handy tool carrier also serves as a seat when you do those low jobs that normally cramp the legs. The one I made has space for about 50 commonly used tools and wrenches, enough for just about any home repair.

The tool holders can be custom-fitted to your own tools. I drilled wood blocks to fit my punches and sockets, and glued and nailed the blocks to the carrier sides.

A measuring tape rides in a plastic holder tacked to the punch block. Hooks made from nails were placed on the back for box-end wrenches. Holes drilled in the edges of the vertical supports take set-screw wrenches.

I put two coats of enamel on the completed carrier and tacked thin rubber pads under the corners of the base.—Arthur J. Garinger, Dallas, Pa.

HOW TO CUSTOM-BUILD A

Carrying Case

Need a case to hold your camera outfit, lab equipment, or other hardware? Here's a beauty

By John Burroughs

BUILDING a fitted case is easy shop-work once you've planned the job. It's deciding how that's tricky.

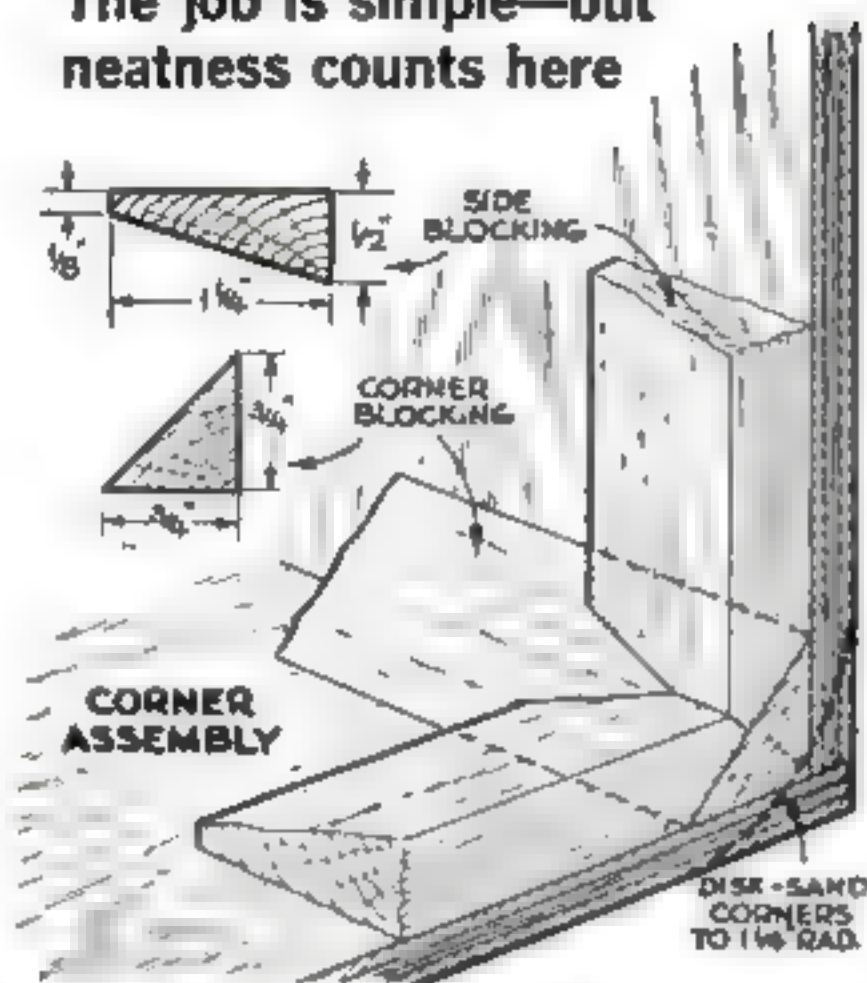
There are three decisions: what materials to use for the body, what sort of molding to

CONTINUED



There's a place for everything in this fitted case, and everything fits just right. The author's measures 15" by 19" by 5". For best arrangement, lay out all your gear first on a piece of paper to determine the dimensions of your own case.

The job is simple—but neatness counts here



Reinforce corner joints with glued-in triangular and wedge-shaped strips, tacking them into place. Then glue the plywood panel on top of the case to make it a fully enclosed box.



After fitting all the partitions, glue (and clamp) $\frac{1}{8}$ " hardboard strips to the inner sides of the case's lower section walls. These will form a sealing lip along the line of closure.

use, and how to cover the finished box

For some time I'd wanted a compartmented case to hold two $2\frac{1}{4}$ -by- $2\frac{1}{4}$ cameras and plenty of accessories—a case reasonably good-looking, yet sturdy enough to give my equipment adequate protection. But the camera cases I found weren't suitably divided, and prices were way out. I thought about installing partitions in a regular suitcase, but the inexpensive overnight cases I looked at seemed too flimsy. I decided to build a case from scratch.

What to make it of? I considered fiber-



Sand all outside surfaces smooth before covering the case. To make sure there are no sharp corners to cut into the fabric covering, bullnose all edges with a sanding block.

glass, but since making molds would involve too much work, I chucked the idea. I also considered resin-laminated, bent-veneer side walls. And there were a half-dozen other possibilities.

I settled for wood and very simple construction—a plywood box with blocked joints. I could build a wooden case solid, I reasoned, and cut it apart.

After figuring inside dimensions that allowed for cushioning, I glued up the box from $\frac{1}{2}$ " plywood, reinforcing the joints with wood strips—short triangular strips in



Round off the corners of the case to a $1\frac{1}{2}$ " radius. The easiest way to do this: Use your bench-saw sanding plate or a disk sander that's faced with a coarse-grit sanding paper.



Now cut the case apart on your table saw with a sharp, thin-gauge saw blade. This is a ticklish job: Make the cut slowly and carefully to avoid splintering the plywood edges.



Cover the top and bottom of the case with a fabric-backed vinyl upholstery material. Contact-cement the covering, pulling the edges down smoothly and tacking them, as above.

the corners and mitered wedge-sectioned strips along the walls—before gluing on the top. After assembling it, I rounded the four corners on a sanding disk and sliced off the lid on a table saw. Then I installed main partitions in the body and glued strips of hardboard along the walls to form a lipped seat for the lid.

Most commercially built cases are trimmed with metal or plastic moldings to hide seams in the covering. I found my trim in ordinary aluminum cap molding—the kind with a .070 slot sold for edging $\frac{1}{8}$ "



Aluminum cap molding hides the tacks that secure the top and bottom coverings. Screw the molding in place in the rabbets around the case. Fill the screwheads flush with cold solder.

plastic laminate. I could cover the case top and bottom, then screw the molding over the edges of this covering, finally slip the covering into the slot in the molding.

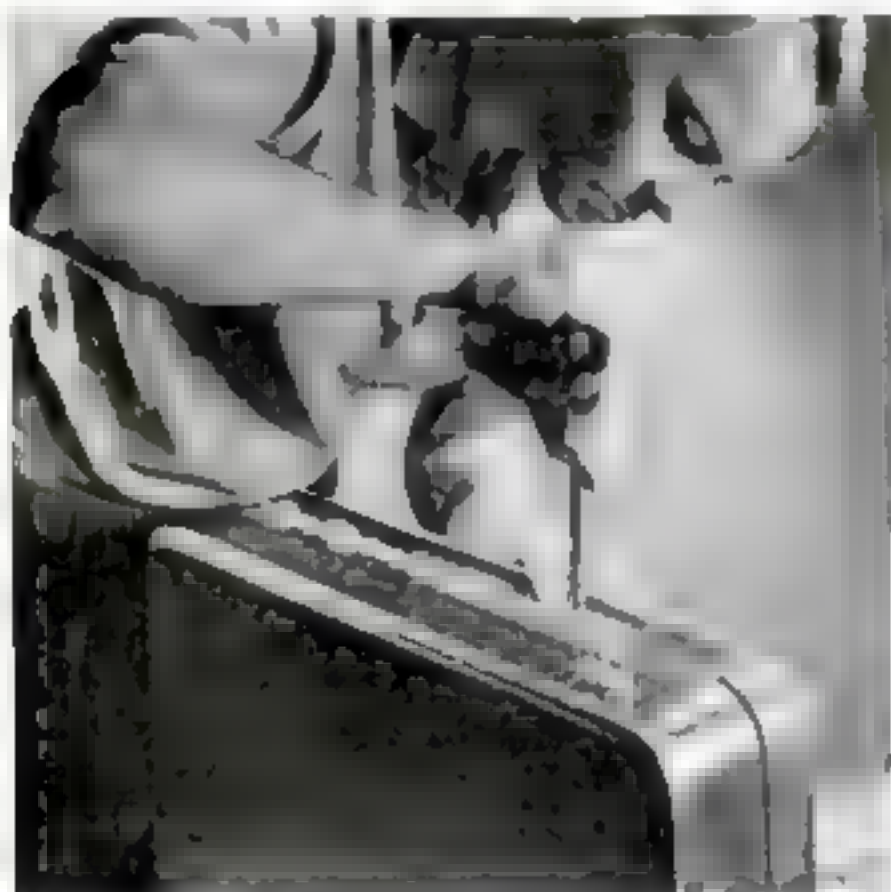
This scheme, however, involved cutting shallow rabbets around the box and setting the molding flush. To know how deep to cut the rabbets, I had to decide what material I'd use for covering the case.

Thin leather might scuff, I thought, and I might have trouble pulling heavy leather over the edges of the case smoothly. The cheap artificial leathers I found wouldn't do.

Finishing touches produce a handsome case



Side covering is brushed with cement and slipped into the cap molding. Turn the vinyl material over the edge along the closure line, and trim so that it butts against hardboard lip.



Hinge the case lid to the body with a length of nickel-coated $1\frac{1}{4}$ "-wide piano hinge, inseting the hinge into the covering. Check to make sure that the lid closes squarely.

But in an upholsterer's shop I spotted some of the new expanded-vinyl upholstery materials used for covering deep-spring furniture: beautifully stretchy, knit-cotton-backed, $\frac{1}{16}$ "-thick, 54"-wide, \$5-a-yard materials that looked more like leather than leather. I bought one running yard, charcoal gray.

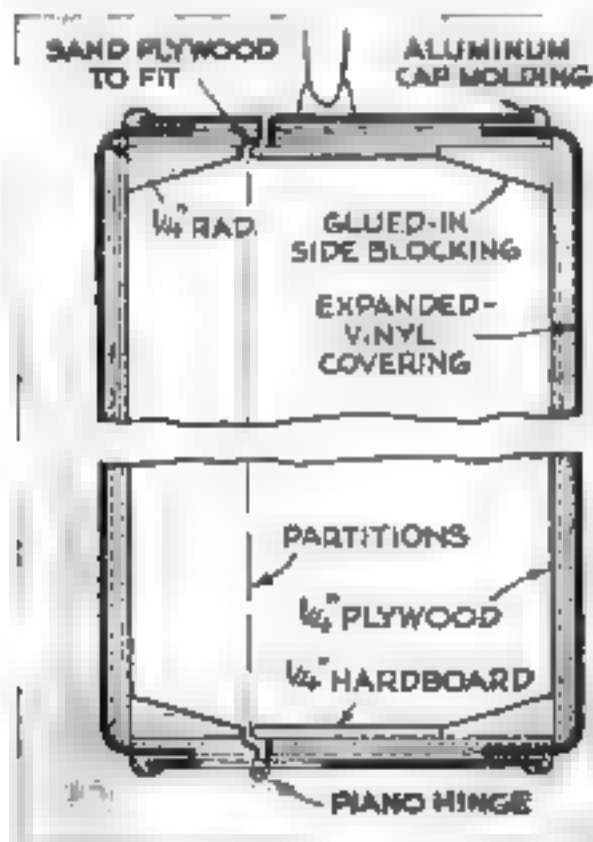
After cutting $\frac{1}{8}$ "-deep rabbets around the box, I bullnosed all the edges of the case with a sanding block. Then I contact-cemented squares of vinyl on top and bottom, pulling the edges over the bullnosed corners and tacking the material along the rabbets. I screwed aluminum molding in place over the tacks and filled the screw-heads with cold solder.

Next I cut a long strip of vinyl to cover the side walls, brushed the material generously with contact cement, and, with the cement still wet, slipped the covering into the molding groove. I trimmed this covering to butt against the hardboard lip.

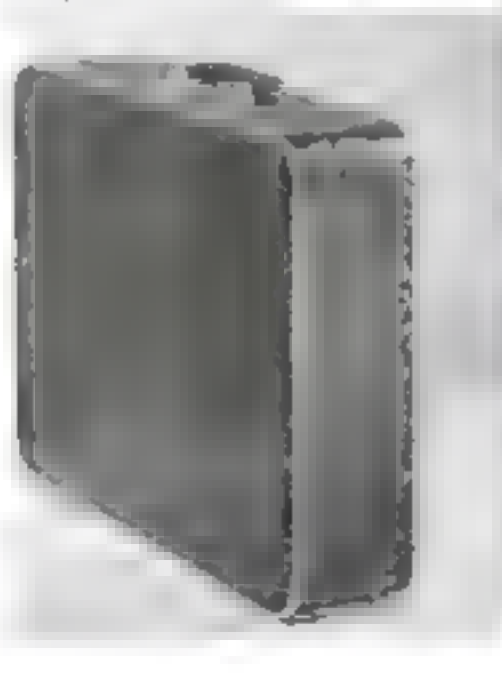
Before covering the sides of the lid, I sanded a bevel around the inner edge to allow for the thickness of the vinyl. Then I pulled the covering under the edge, trimmed it to butt against the lid's wedge-sectioned strips. The lid fit perfectly.

To hinge it to the body, I used nickel-coated piano hinges. I fitted on a handle, catch, and half-round metal feet.

Covering chunks of $\frac{1}{2}$ " sponge rubber with leftover vinyl, I made resilient, matching pads for the camera compartments. And I used vinyl-covered $\frac{1}{2}$ " hardboard for additional dividers. After rubbing cemented edges with black cement, I painted the interior flat black and cemented pads on the lid to grip the cameras. ■ ■



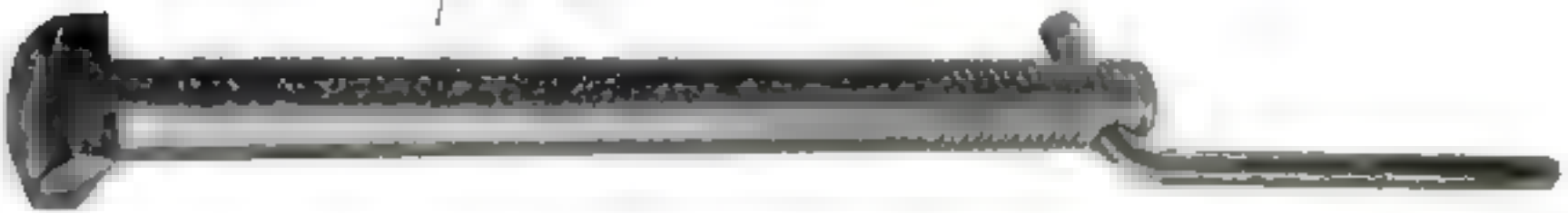
Fit dividers as needed into finished case (shown in cutaway, left) and nest your cameras and gadgets in their compartments, using vinyl-covered $\frac{1}{2}$ " sponge-rubber padding. Add carrying handle and necessary latching hardware





Bolt extends reach of Allen wrench

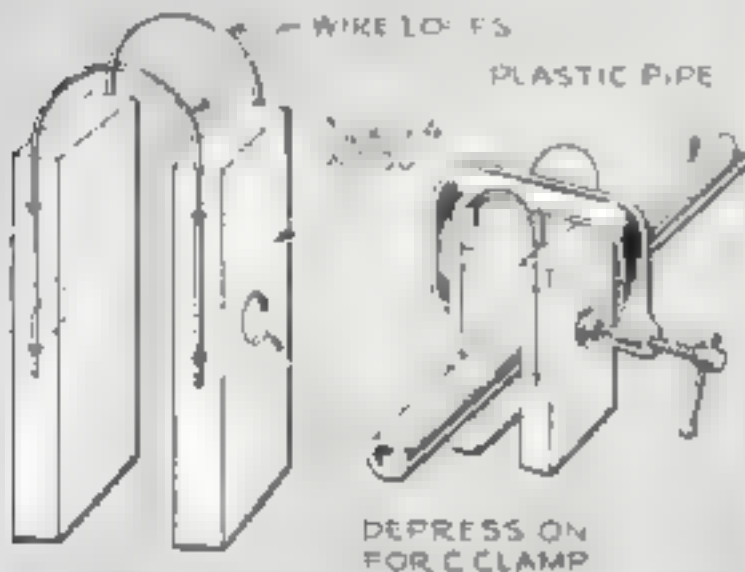
Socket-head capscrews, often called Allen screws, are sometimes difficult to break loose—or tighten—in hard-to-reach spots. The problem can be solved by drilling a good-sized hole so the short side of the wrench fits snugly in the hole. I found this helpful in removing a large number of the socket-head capscrews from the oil-pan flange of a foreign car.—*E. F. Lindsley, East Troy, Wis.*



▶▶▶After trying many methods for removing the bubbles that appear when varnishing furniture, I hit upon this simple procedure:

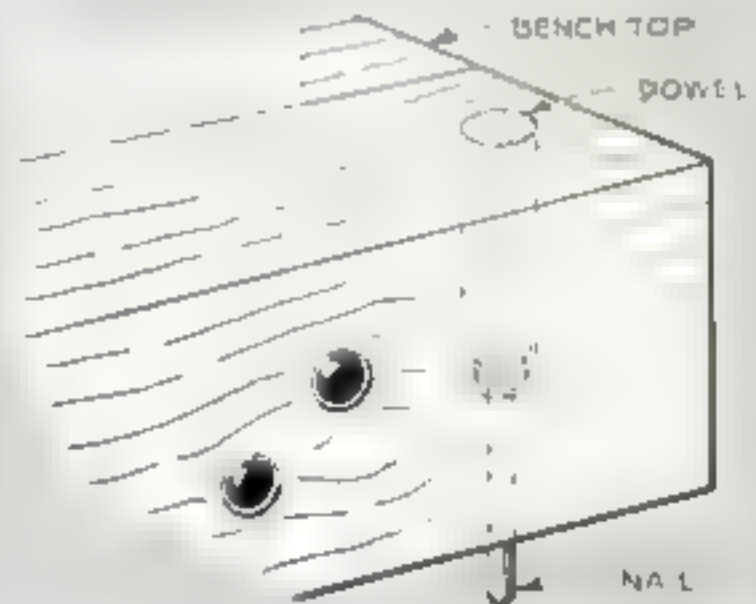
Spread the varnish over the surface and brush it out lightly. In a few minutes wipe

off the excess with a cloth soaked in the varnish. (Use a lint-free cloth or you'll have another problem on your hands.) If this is done properly the varnish will remain on the surface, but the bubbles will disappear.—*Archibald Black, Stafford Springs, Conn.*



Clamp shuts off plastic water pipe

In working on a country-home water pump it's convenient not to lose the prime. I do this by using the clamp above on the plastic pipe that delivers water from the well. Holes drilled part way through the wood blocks keep the C clamp from slipping. Before you compress the pipe, soften a section of it with hot water. This lessens the chances of splitting the pipe.—*R. B. L. Snow, Muskoka, Canada.*



Snug spot for a workbench dowel

Many workbenches have the front edge drilled for a dowel, which supports the far end of long boards held in the vise. But the dowel is in the way when not in use. To remove it—and still keep it handy—drill a dowel-size hole in the bench edge. Drill a smaller hole at the bottom and drop in a nail. A push up on the point of the nail pops up the dowel.—*Carole Knutson, Bismarck, N.D.*

Now: Cameras You Load Like a Gun

Exciting new pop-in-place film cartridges from Kodak let you load, aim, and shoot in seconds

By Bob Hering

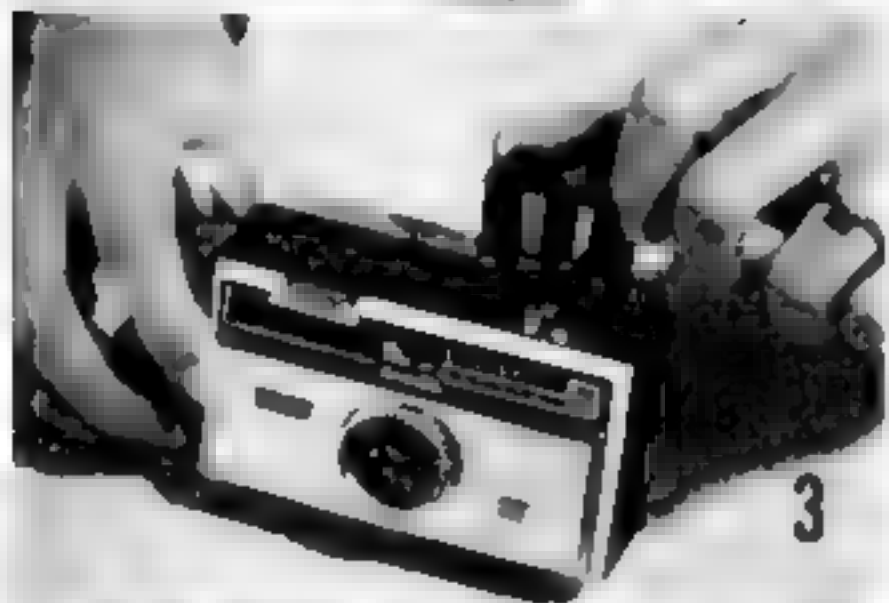
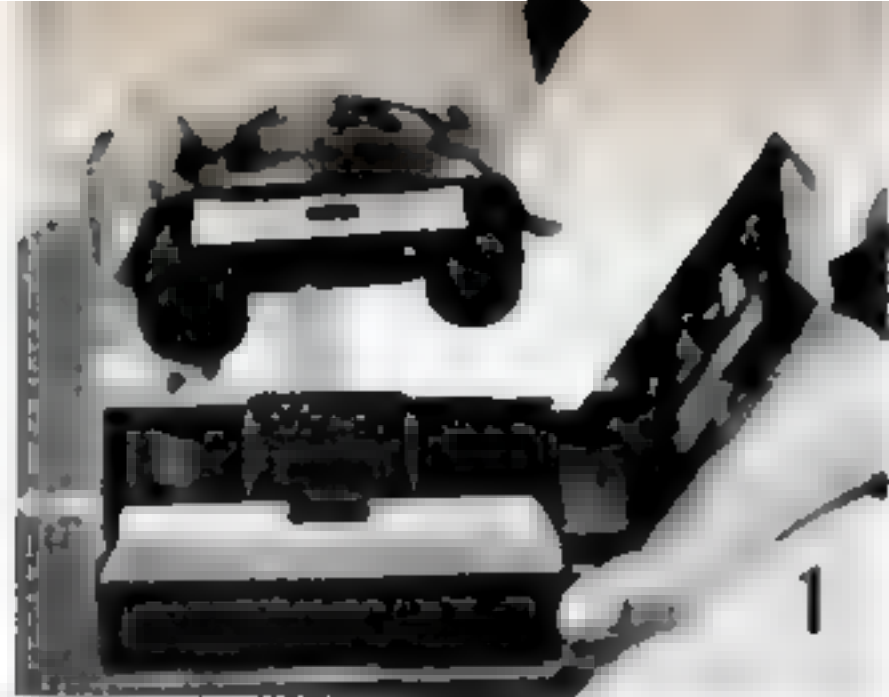
I'VE just had a look at four new automatic cameras that introduce a great idea in the popular-price field: They end conventional film loading. Gone is the fuss and fumble. Now you simply pop in the film and shoot—as fast as you can load a gun. The new automatics also set your exposure for you, have a built-in pop-up flash holder, and even change shutter speed to suit either indoor or outdoor shooting.

The key to the new system, just announced by Eastman Kodak, is a preloaded film cartridge. Drop in a cartridge, close the camera, and you're ready to shoot. When you've finished a roll, you lift out the cartridge and send it off for processing. All of Kodak's four new Instamatic cameras use the sealed Kodapak cartridges. The advantages.

- You can safely change a cartridge in bright sunlight because it's completely light-tight.

- It's impossible to load a camera in the wrong way; the chamber accepts the cartridge only in the right way.

- On three of the four cameras, a notch in the cartridge automatically sets the exposure mechanism to match the speed of



Loading an Instamatic camera is easy. Just open the camera back, drop in the film cartridge, and snap the back shut (1 and 2 above). Through the window in the camera back (2) the type of film and number of the next exposure automatically appear. For flash, you simply pop up the built-in flash holder (3), insert bulb, press shutter release (4).

Instamatic 300 includes an electric-eye automatic exposure control, a fixed-focus f/8 color-corrected lens, pop-up flash holder with automatic shutter-speed shift from 1/60 for outdoor shooting to 1/40 for flash. Price of camera is about \$45.

Deluxe model 700 has, in addition to the convenient features of the three lower-priced models, a fast f/2.8 lens, speeds from 1/50 to 1/250 and a protected frame finder with low-light signal and focusing symbols. It's the costliest: about \$110.

Medium-priced model of the new line is the Instamatic 400. The distinctive feature of the 400 is its motorized film advance. Spring power lets it take 10 exposures in 10 seconds. You can snap picture sequences rapidly. Price is about \$53.



Budget-priced Instamatic 100 has fixed-focus f/11 lens for shooting from four feet to infinity, plus automatic exposure. Shutter shifts automatically from 1/90 to 1/40 when flash holder is popped up. Price, about \$16.

Loading is foolproof with the new Kodapak film cartridge shown above. No film leaders or sprocket teeth to worry about. You simply drop the cartridge into the camera. You can't go wrong; there's only one way to do it.

the film. (The 100 model is the exception.)

The new cameras are surprisingly compact. Three are four inches long; one is five inches. Features common to all four models include: film advance with automatic film stop, double-exposure prevention, and built-in pop-up flash holders.

Four different 126 films are packed in the cartridges: Verichrome Pan, Kodachrome-X, and two new films—Kodacolor-X and Ektachrome-X. This gives you a choice of color prints, color slides, or black and white prints. Both Kodacolor-X and Ektachrome-X are twice as fast as the regular

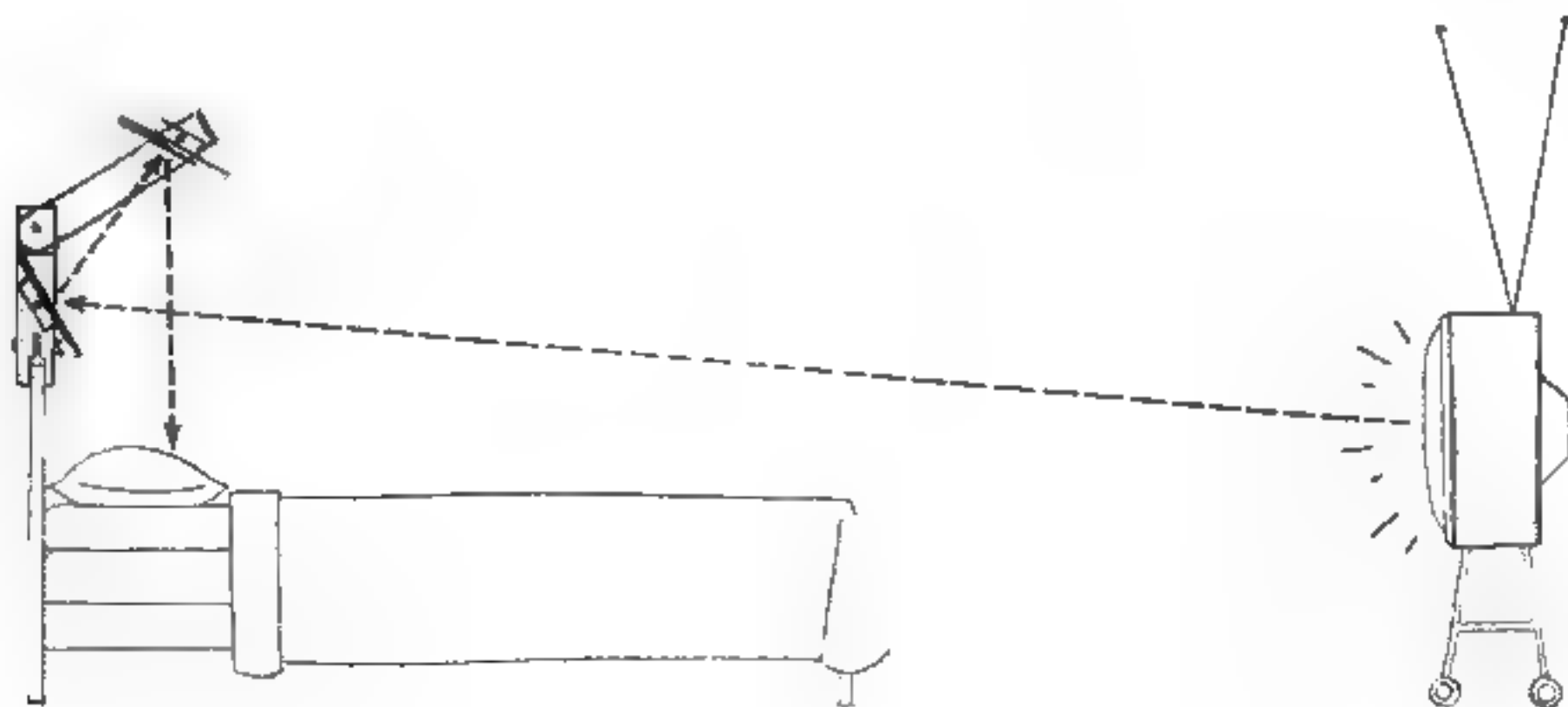
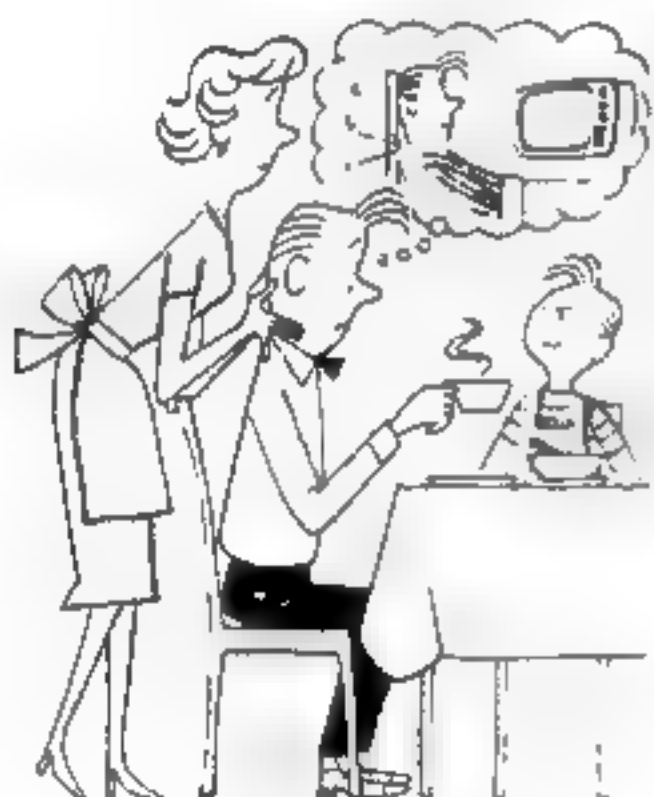
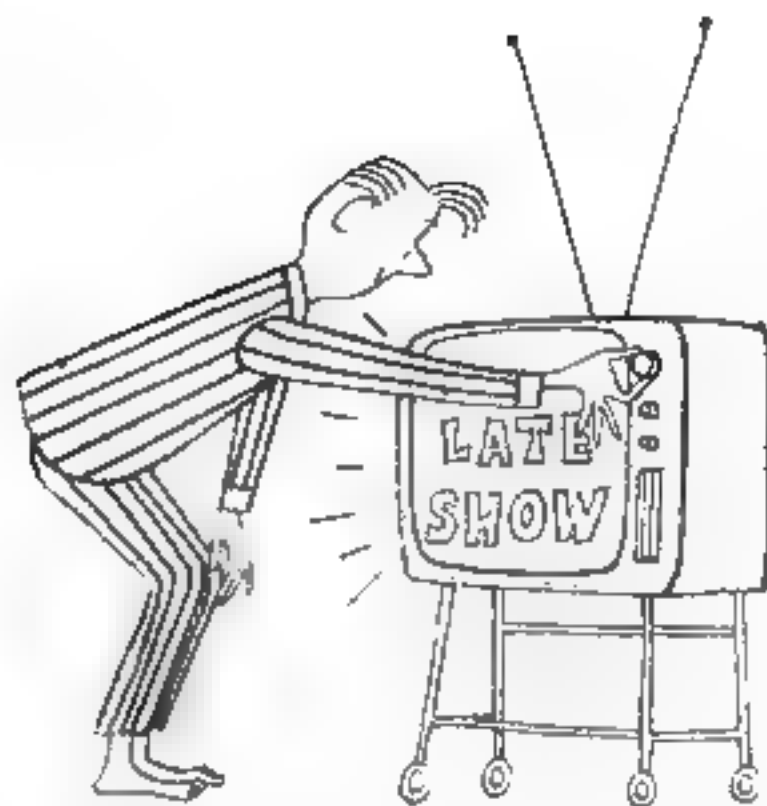
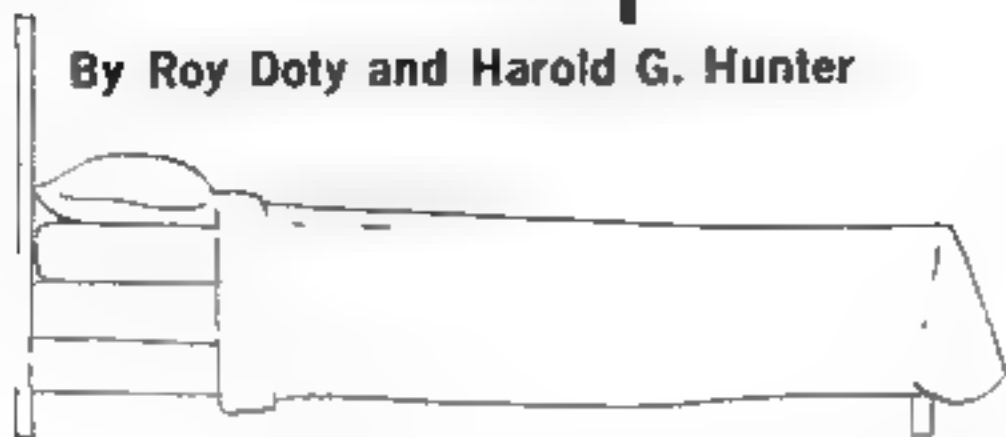
Kodacolor and Ektachrome they replace.

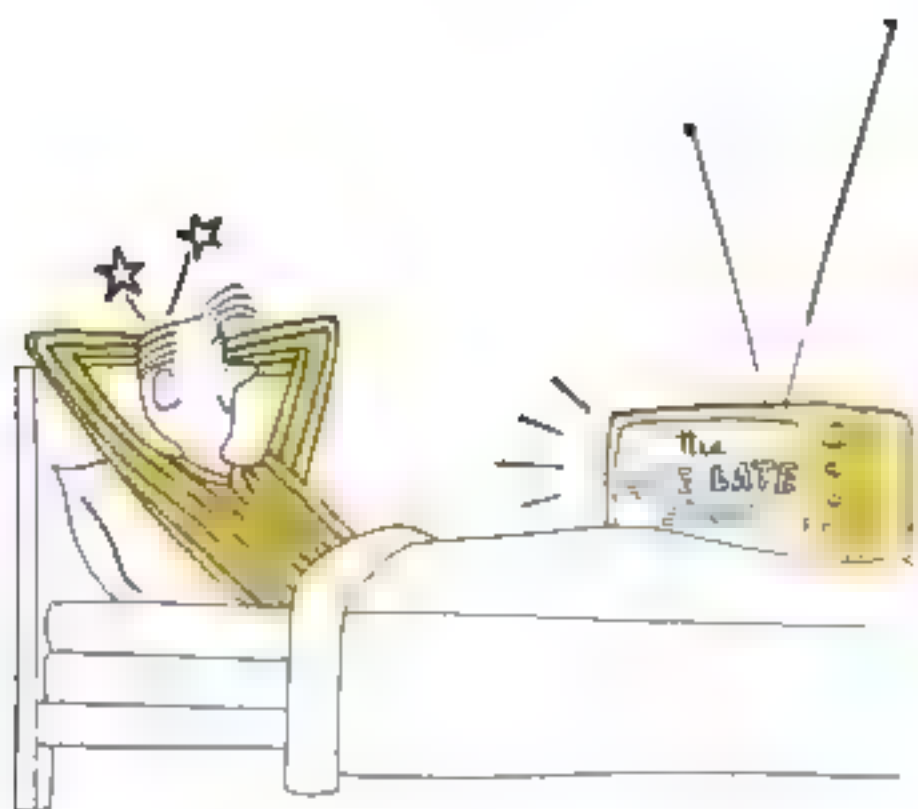
The built-in flash holders pop up to operating position on release of a catch. You can leave a fresh flash bulb in the holder without firing it; it can't go off with the reflector down. As the bulb pops up, the shutter sets itself for flash. On the 700 model, the correct lens aperture for flash is set automatically as you focus in the 3- to 25-foot range.

Advancing the film is simplicity itself. A short-stroke lever operates rapidly with your right thumb. On the 400, there's a motorized film advance.

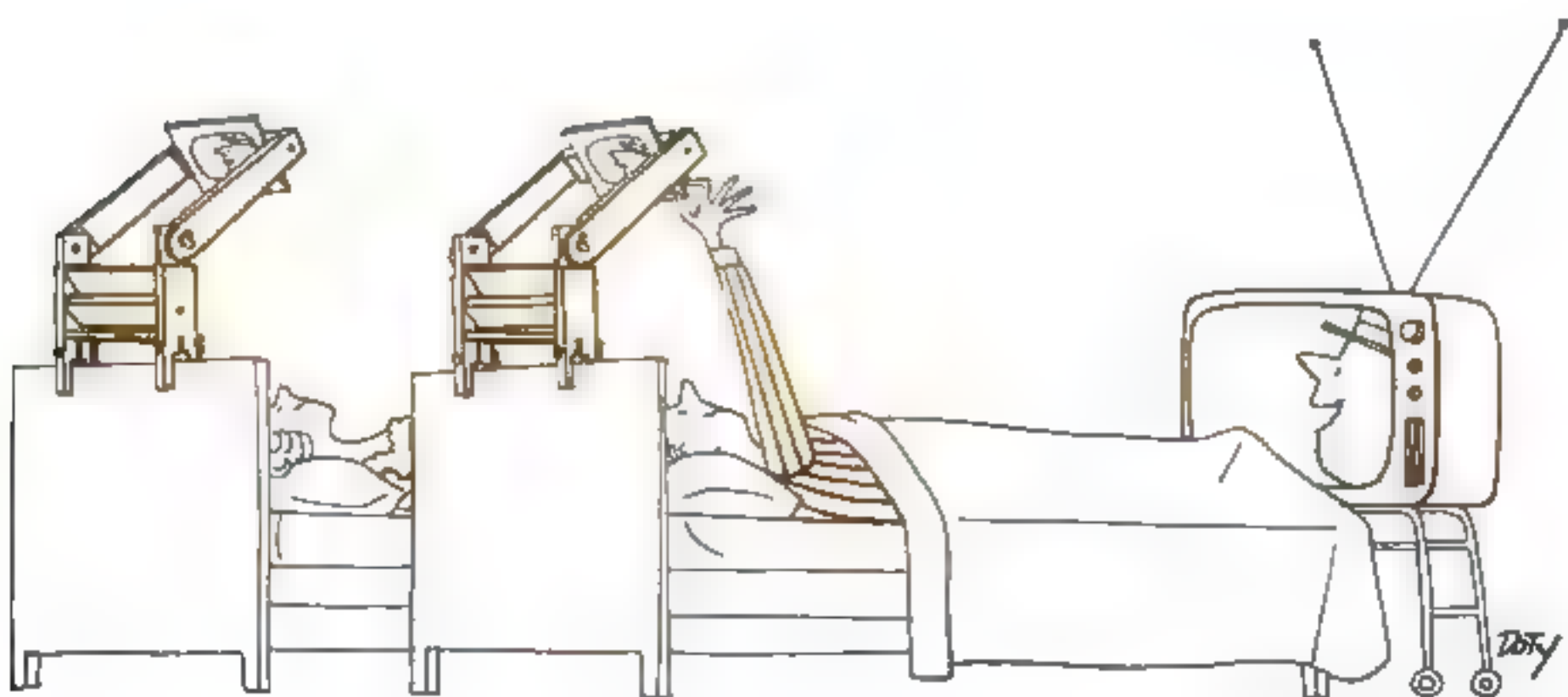
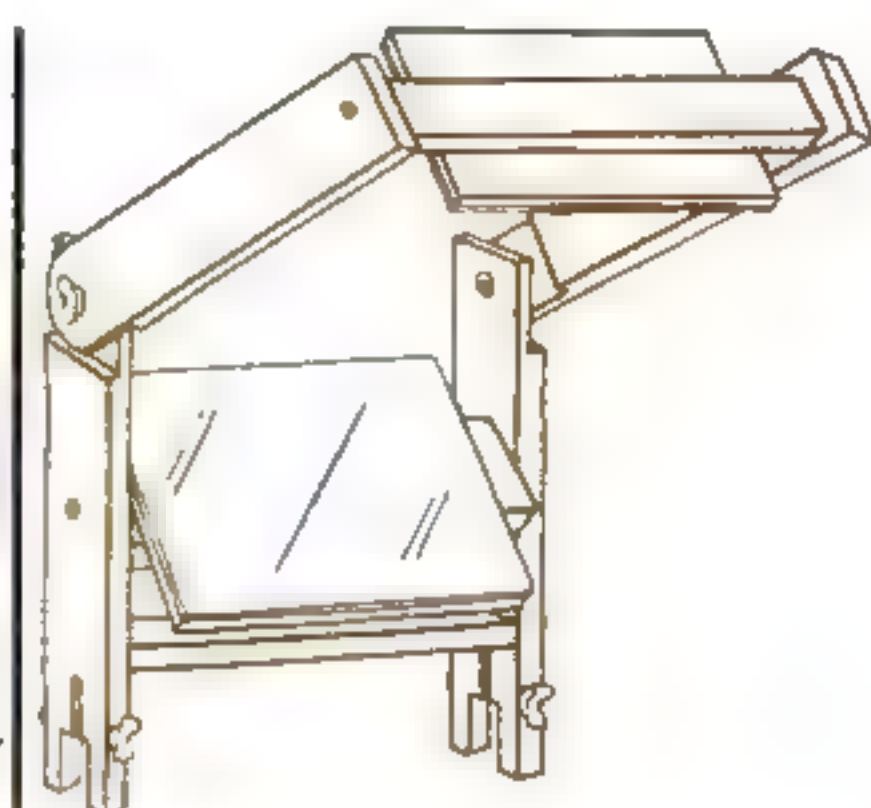
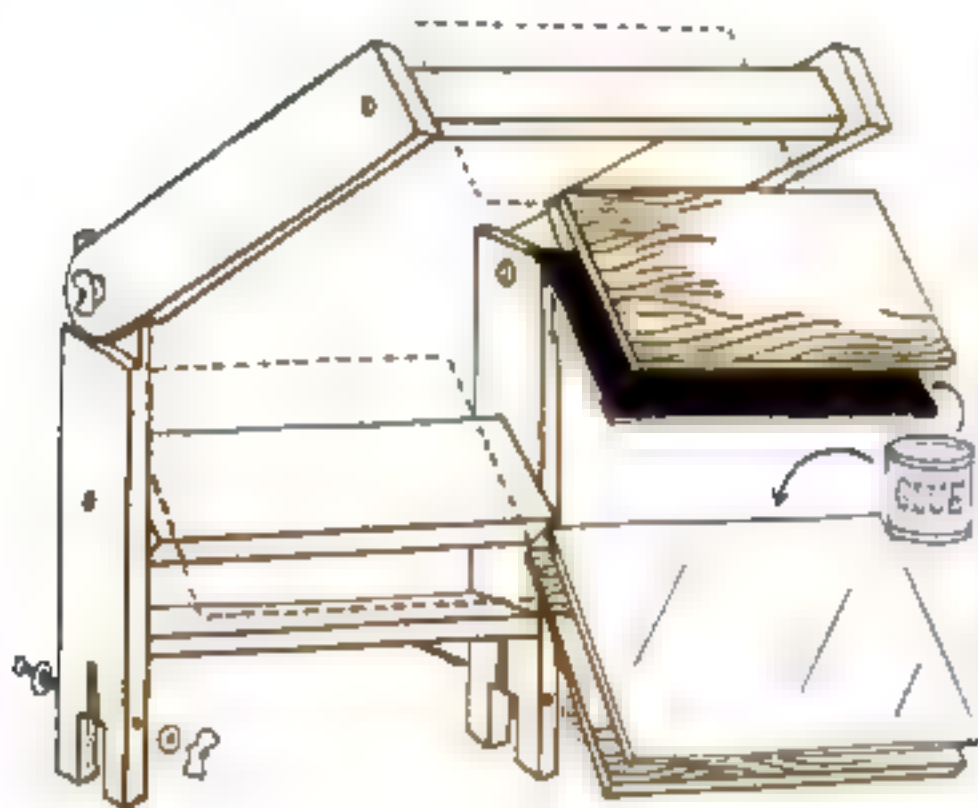
Wordless Workshop

By Roy Doty and Harold G. Hunter





MORNING!

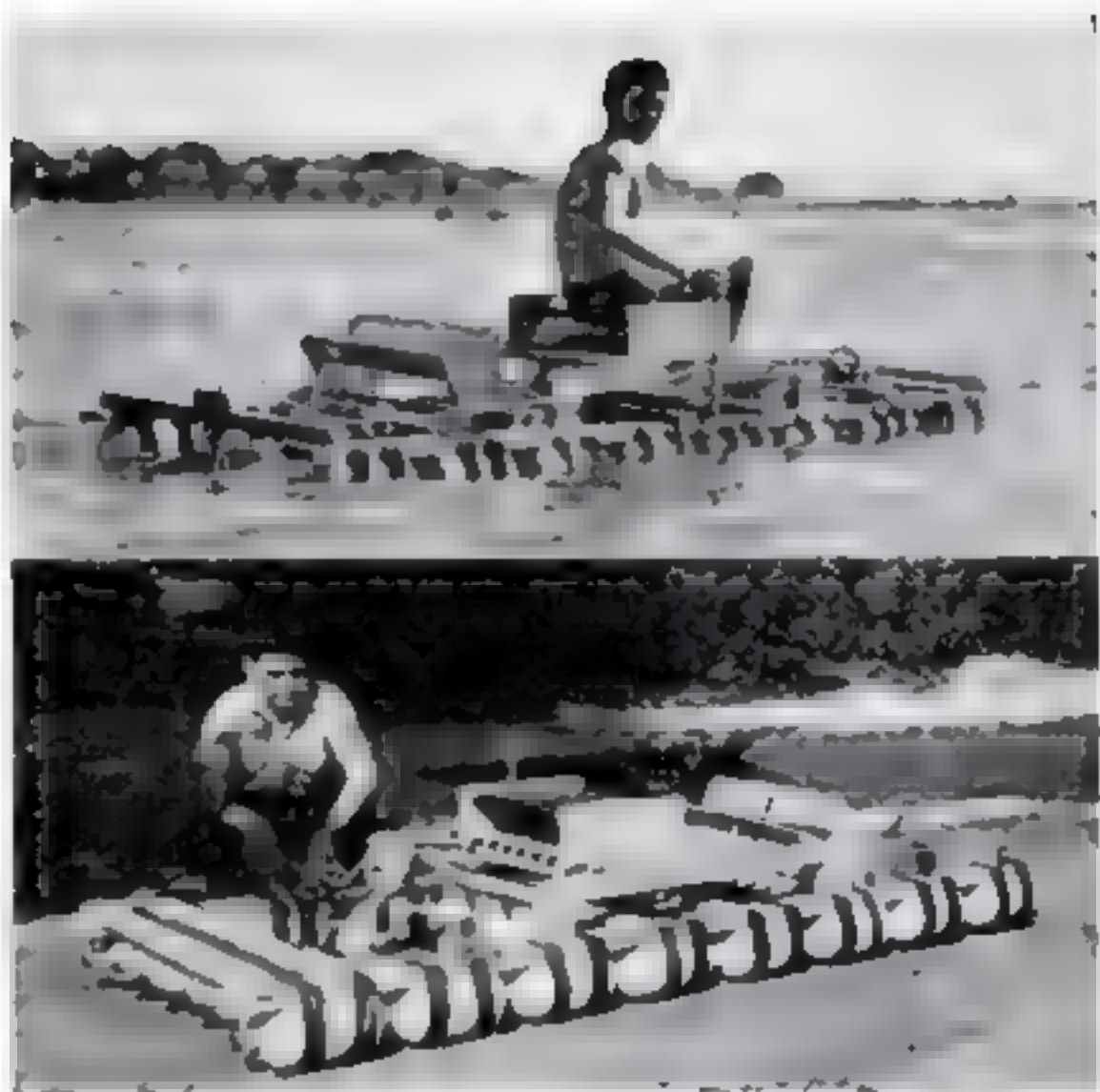


Self-propelled raft buoyed on air

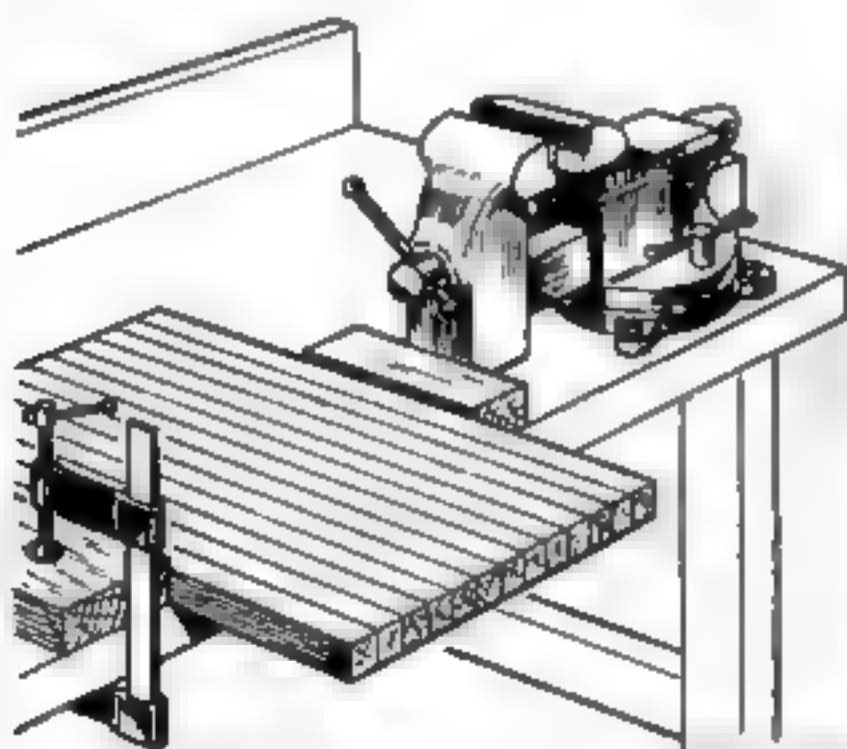
A water vehicle like this one will never break speed records, but it offers inexpensive fun afloat for both kids and adults.

The cost of materials for this 9'-long pedal craft is negligible. It's buoyed up by discarded plastic bottles—30 one-gallon containers of the kind your wife buys bleach in at the supermarket. I secured the bottles to the frame with 2" bands of rubber made from inner tubing. The frame can be made from whatever lumber you have on hand.

The drive mechanism for the large rear paddle wheel is the same propulsion system used on a kid's pedal car. There's no motor

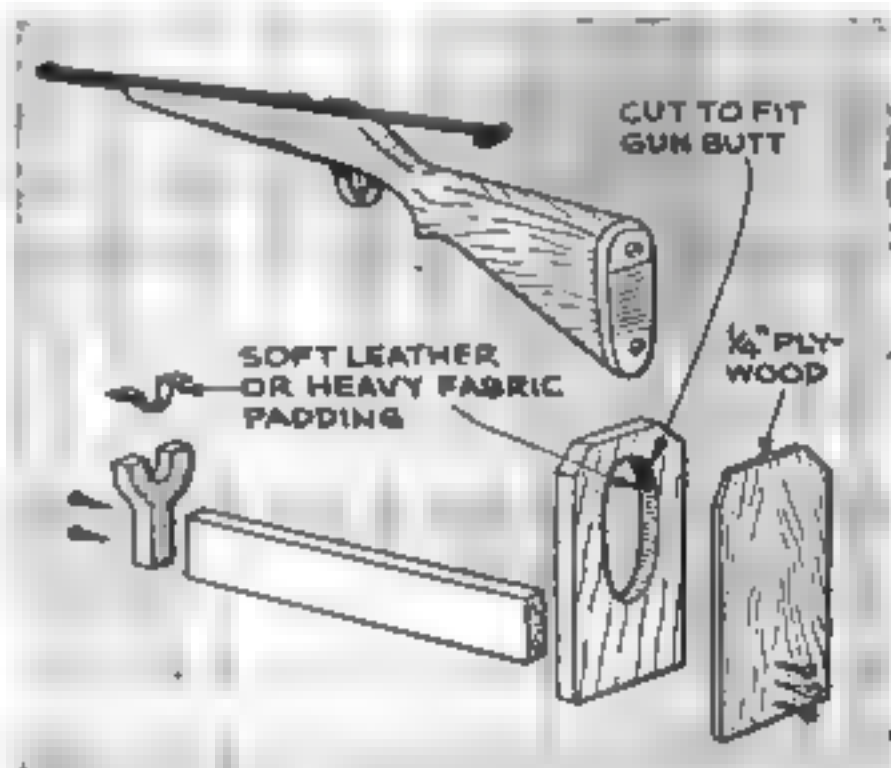


to fool with—and the ignition system is certainly waterproof. The little craft is fine for calm-water pedaling or lazy fishing on a quiet stream.—Edward Simon, NYC.



Vise substitutes as clamp

To do a big glue job, I needed longer clamps. As a substitute, I rigged up this arrangement. On one side, I made a bench stop by clamping a wooden block to the workbench. On the other side, I used my machinist's vise and a buffer block to apply pressure. The buffer block kept the vise from marring the workpiece. Careful, though—too much clamping pressure will buckle the boards.—Joseph Schiller, Milwaukee.



Gun mount for rifle cleaning

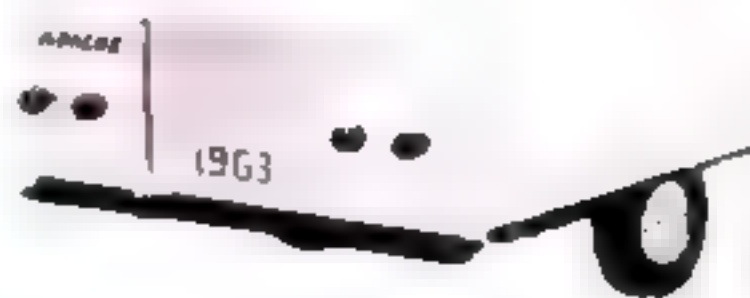
Your rifle will last longer and shoot straighter if cleaned after each use. Since the rod may carry grit, to save the muzzle end you should clean the barrel from the breach, where possible. But it's mighty unhandy to hold the rifle with one hand and work the rod with the other. I solved the problem with a mount (above), made from two-by-four, scraps of plywood, and a bit of soft leather.—James W. Davis, Boise, Idaho.



Vacationing on Wheels

**Tent Trailers
Camping Vans
Piggyback Campers
Car-Top Sleepers
Station-Wagon Tents . . .**

Tent trailers like these—shown in use above and on the road at right—will be more popular this year than ever before. (Photos courtesy Vesely Mfg. Co.)



**. . . all on
the following
26 pages**



TENT TRAILERS

buy or rent one

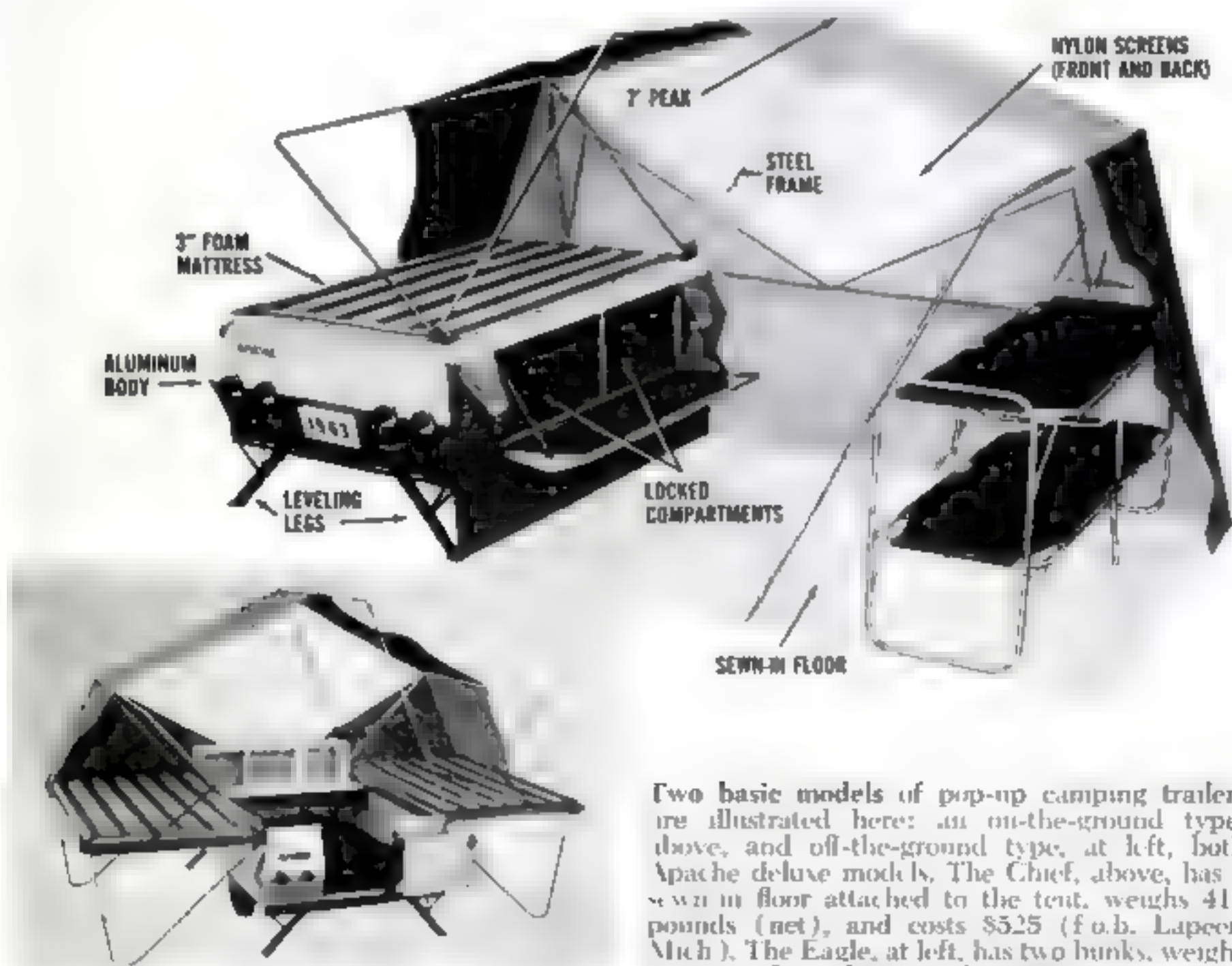
HOTTEST item in camp shelters this year is a cross between a tent and a trailer. You trail a low and compact box on two wheels behind your car. At the camp site, you fold out a tent on a metal frame to make spacious living quarters.

Pioneered in recent years under such trade names as Apache, Nimrod, and Heilite, pop-up camping trailers have broken out all over the map this season. New manufacturers are hustling into the field and more rental agencies are catering to those who would rather rent than buy one.

Pop-ups have all the appeal of tent camping. But taking down a soaking tent and trying to pack it in your car is no part of the fun. Tent-trailers go up faster than the simplest tent, and provide bunks (often all made up) and extra storage space.

Those who have used pop-ups say that they offer one of the most satisfying ways of vacationing on wheels. They are comparatively inexpensive (from \$375 to \$850), they tow easily on the road, they do not obstruct your vision to the rear, they are a cinch to store, and their light weight results in gas economy. You can even manhandle a pop-up easily into an off-the-road camping site.

Tenting on wheels. The new pop-up tents pack into a trailer 7' to 8' long, 4' to 6' wide, and about 3½' high. There are two basic styles: an off-the-ground type with a



Two basic models of pop-up camping trailers are illustrated here: an on-the-ground type, above, and off-the-ground type, at left, both Apache deluxe models. The Chief, above, has a sewn-in floor attached to the tent, weighs 410 pounds (net), and costs \$525 (f.o.b. Lapeer, Mich.). The Eagle, at left, has two bunks, weighs 550 pounds, and is priced at \$645.



Off-ground types. At left is Nimrod's Riviera, priced at \$699 F.O.B. It has two double bunks that open out fore and aft of the steel trailer. In

contrast, bunks on the Two Star (\$599) at right open out, like wings, on either side of the trailer. Nimrod's third model is an on-ground type.

fold-out bed on each side; and an on-the-ground model that leaves a single three-quarter bed atop the trailer, while a canvas top flips up over it and extends out to one side and down to the ground, providing room for several cots on a sewn-in floor.

All tent ads read "easily erected," but these *are*—and by one person, in about three minutes flat. Steel bows swing up and out from the trailer body, stretching

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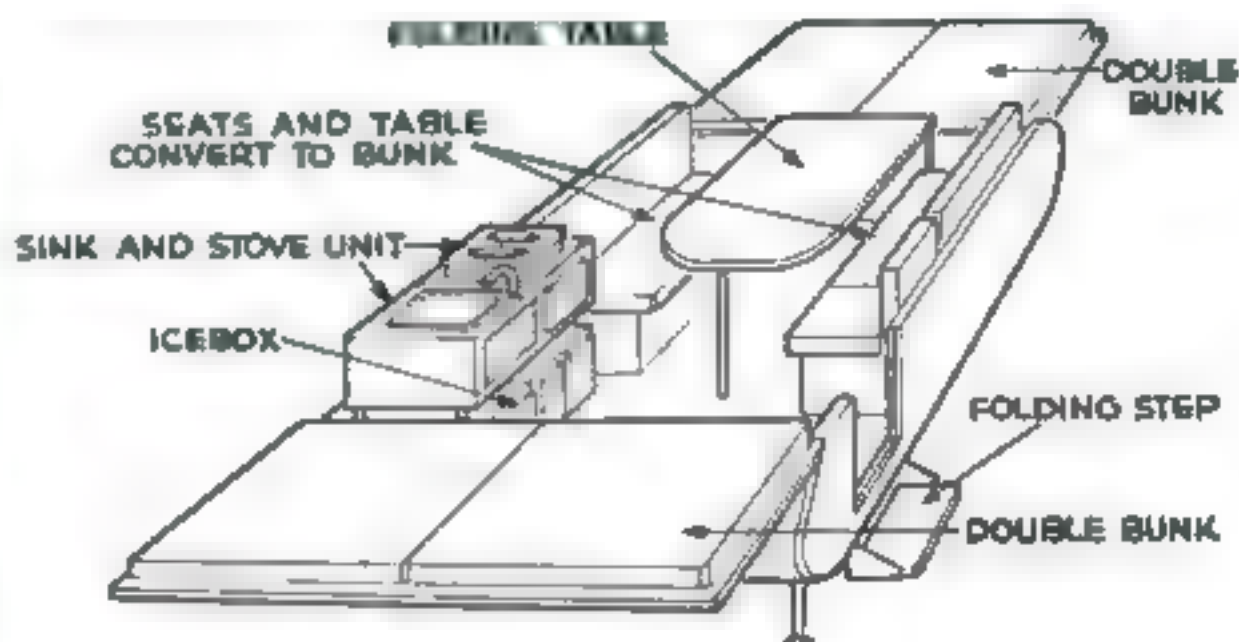


On-the-ground camper sold by Sears gives you more than 100 square feet of space when set up as shown below. Ready for the road as at right the outfit provides 40 cubic feet of storage space. All tent trailers are low enough so the driver can see to the rear without obstruction.





All comforts of home go along in the Trade Winds Continental—including sink. Kitchen unit and table can be removed for use outdoors. Kitchen unit includes double-action pump. A portable propane heater is also included. Flaps on front and rear windows can be propped up as canopies. Prices: \$795 to \$1,200 (f.o.b.).



the canvas top taut. Adjustable legs pull down from the vehicle, supporting it firmly even on rough terrain. A large canopy with side curtains (optional) almost doubles interior space, and screened windows can be zipped closed from the inside.

As in all camping equipment, specifications tend to exaggerate—beds that “sleep

two” range from 3” to 10” narrower than a standard 54” double. Thirty to 60 cubic feet of storage space isn’t quite as much as it sounds; and in off-the-ground models, the storage must be emptied to provide floor space when the tent is in use.

Easy on the road. Compact size and spring suspension make pop-ups a cinch to handle, and their low height (39” to 45”) gives excellent rear vision. Weight (from 340 to 650 pounds, according to model) is nicely balanced, with no more than 50 pounds down-weight on your rear bumper. Interior storage space holds 300 to 400 pounds of extra gear, freeing your car of

[Continued on page 192]



A metal sink is also included in this Right-Sprite, made by Right Products. And there’s a plastic tank in which you can carry along five gallons of water. Factory price is \$595.

CAMPING VANS

buy or build 'em

ANY of the new small vans can now be fitted out as a roomy mobile camper. Shown here are three converted campers you can buy already equipped. The one above and at right is based on the Volkswagen Microbus. The two below are the Ford Econoline (left) and the Chevy Greenbrier (right), the windowed version of the Corvan shown on the next page.

The camper conversions provide seats that fold into beds, a dining table, cabinets, and curtains. Extras include sinks, stoves, refrigerators, water tanks, chemical toilets and hook-on side tents. For panel-truck models, the kits also contain windows. Prices run from about \$400 to \$800.

For three camper conversions you can make yourself, see the following pages.



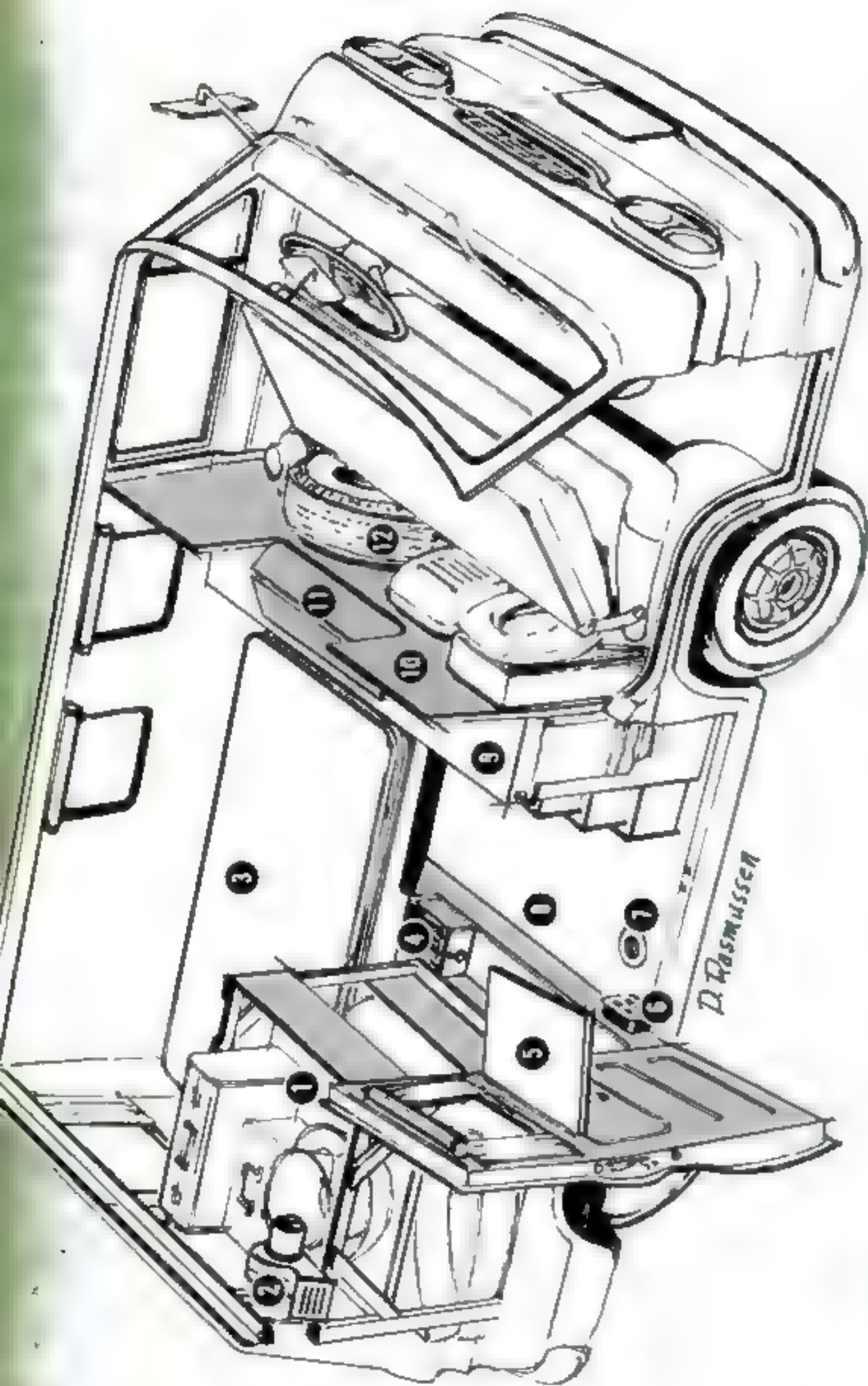
This VW camper sleeps six—four inside and two in roof-top bunk. Side tent adds outdoor shelter. Kits are installed by VW dealers.



Once a panel truck, this Econoline sports windows, living quarters. Conversion kit is sold by Sportswagon Kamperkits, Highland, Calif.



There's even a sink with running water and an icebox in this converted Greenbrier. Camper kits are available through Chevrolet dealers.



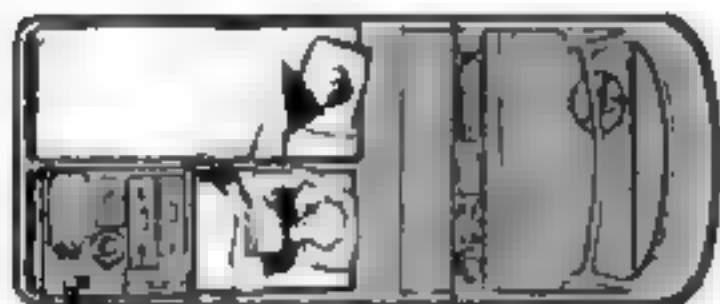
1. Luggage rack
2. Exhaust fan
3. Permanent bed doubles as sofa
4. Tool drawer under bed
5. Folding table on door
6. 110-volt outlet

7. Floor drain
8. Space for second bed
9. Ready-made dresser
10. Partition for privacy
11. Hinged panel for driver's rear view
12. Storage space behind front seat

How to fit out a CORVAN as a camper



Temporary bed (foreground) rests on hinged plywood support in front. When not in use, support is folded up and stored, along with mattress, under luggage rack.

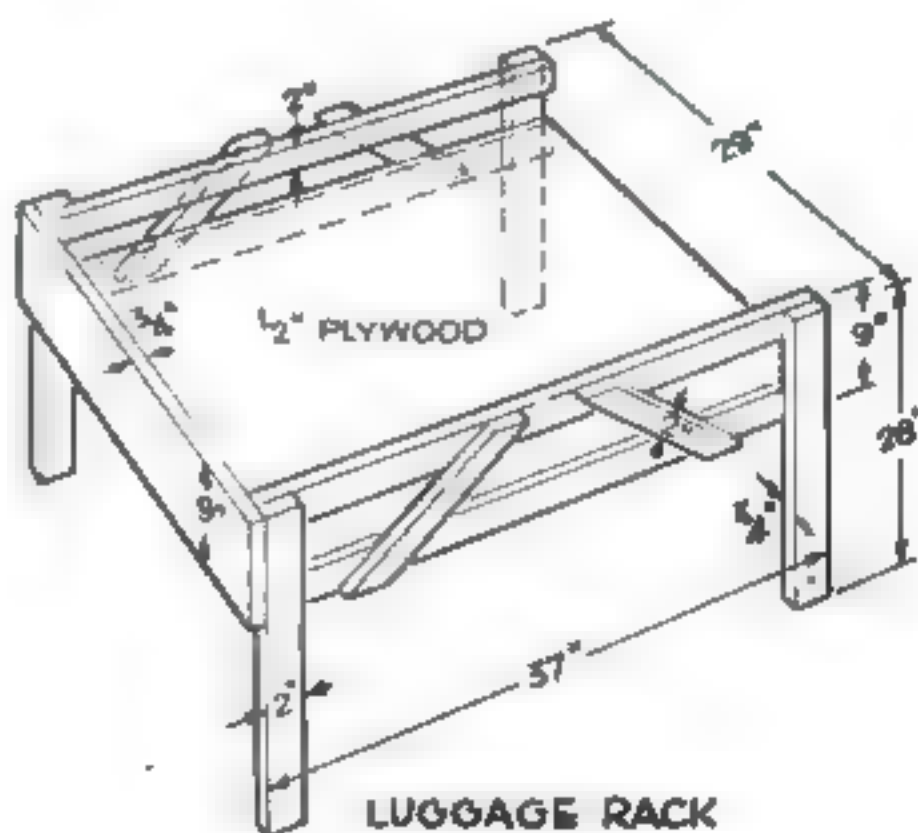
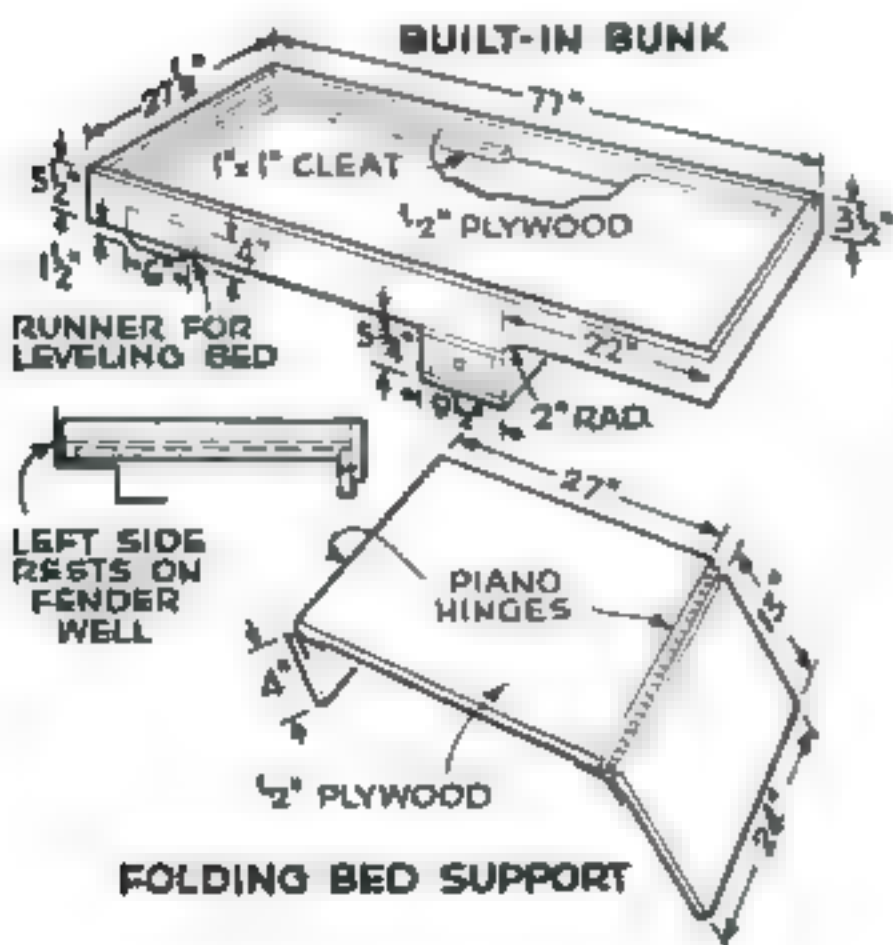


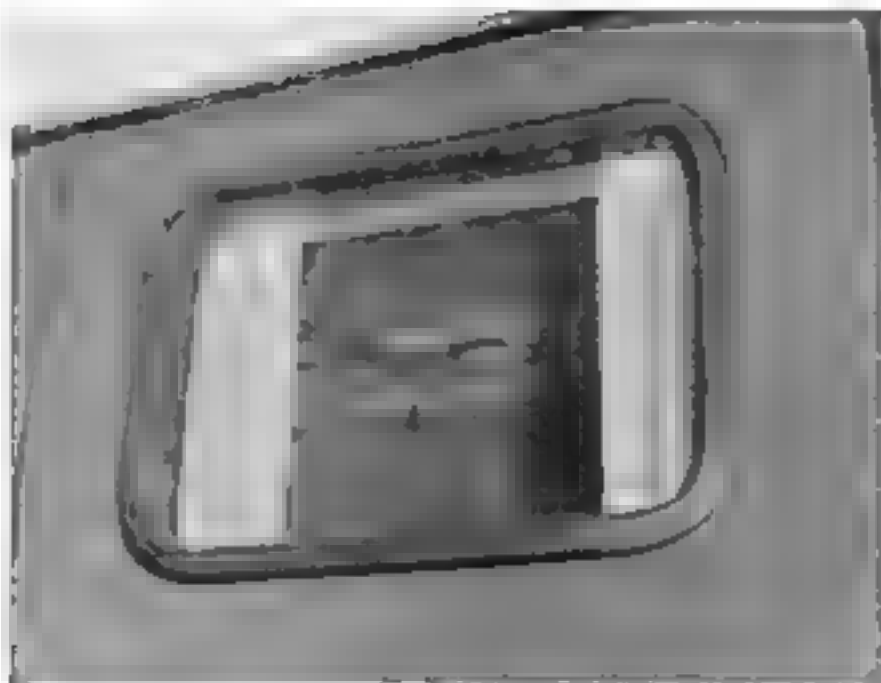
For sleeping, sofa on left side becomes one bed. Other bed is set up under luggage rack on right side.

YOU might think that a panel truck is a fine thing to deliver groceries, but hardly a camping rig. Chet Chatman of Red Bank, N. J., proved otherwise.

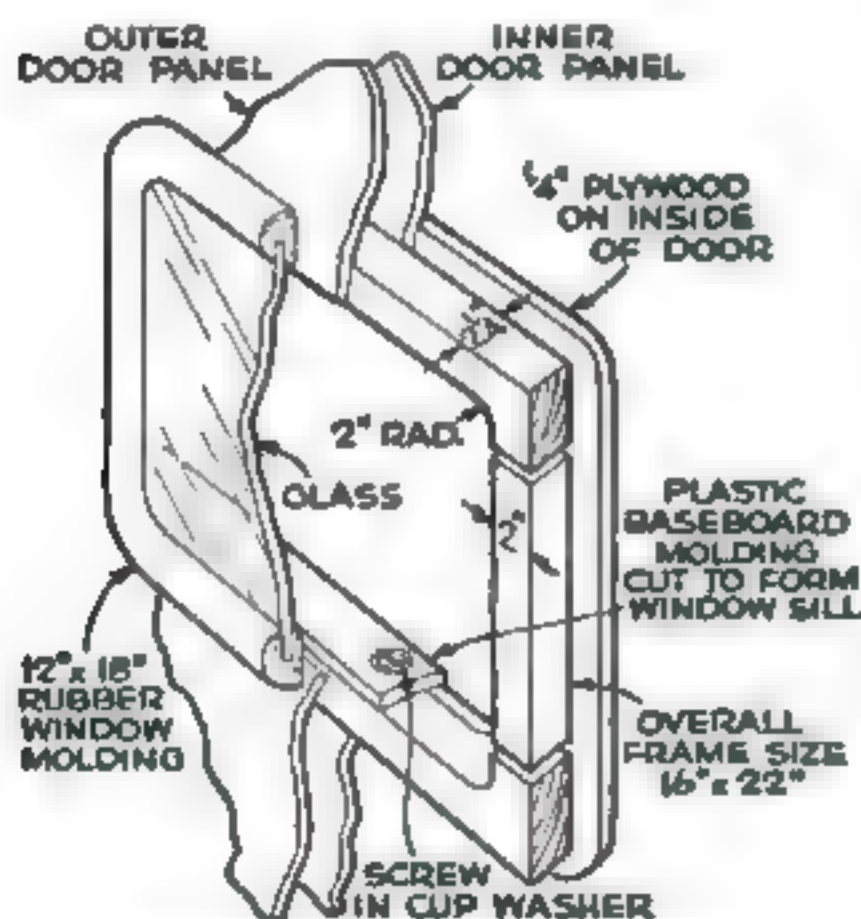
He bought a Chevy Corvair Van, familiarly known as a Corvan, and installed windows, put in beds and other furniture, built in a privacy wall behind the front seat, and doodled up an ingenious mount for a detachable awning. The result, shown on these pages,

CONTINUED





Professional-looking windows like this one can be installed by yourself with stock auto-glass parts. Opening is first cut in outer body panel with a saber saw (with blade broken off short to avoid striking inner panel). Inner panel is then cut in same way. Wood filler blocks are screwed between the panels to form a solid rim, as shown below. Rubber window molding hooks into the opening, and glass snaps into the molding, locking into place.

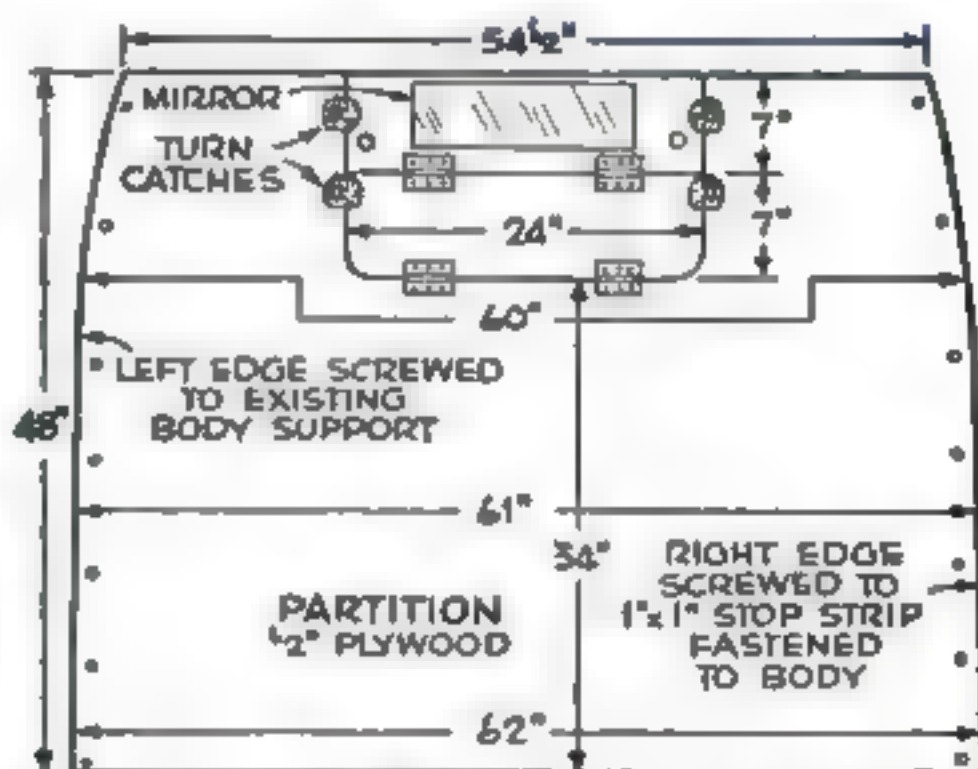


is a rugged mobile camper that can go anywhere and provide a cozy home-away-from-home in any weather. It sleeps two adults on full-length beds in the rear and a child across the front seat.

Why a panel truck? Chatman gives two good reasons. First, a truck generally sells for considerably less than vans designed for family use; it's a bare shell with no windows or fancy interior fittings. Second, because you're buying just space—a whopping 160 cubic feet of it—you can organize it any way you want.

Adding windows is a must, though. Besides making the living quarters homey, they have an important effect on a camper's legal classification. Without windows, Chatman found the van could be licensed only as a commercial vehicle, keeping it off parkways closed to commercial traffic. With windows, the van can be licensed as

[Continued on page 180]



Plywood partition behind driver's seat gives privacy in living quarters. Ready-made dresser below is 57\" wide, fits exactly across van. Drop-down table on door at left is 18\" by 23\".



How to fit out an ECONOLINE as a camper

UP TO six people can share this roomy, roving camper. It's built into a Ford Econoline bus and was designed by Ted Hyman of St. Louis. He chose an Econoline because it's a fine combination of luxury and utility that makes it ideal for camping. Its spacious windows sweep clear to the rear to provide lots of light and view in the living quarters.

At the same time, the low cargo deck stretches level all the way back, to give full-height living space throughout the entire camper. This makes possible an unusual two-level sleeping arrangement. At the top level, two bed boards stretch across the width of the bus and rest on ledges formed by the window sills. These are $\frac{3}{4}$ " plywood and are carefully cut to fit snugly into the windows but without putting pressure on the glass.

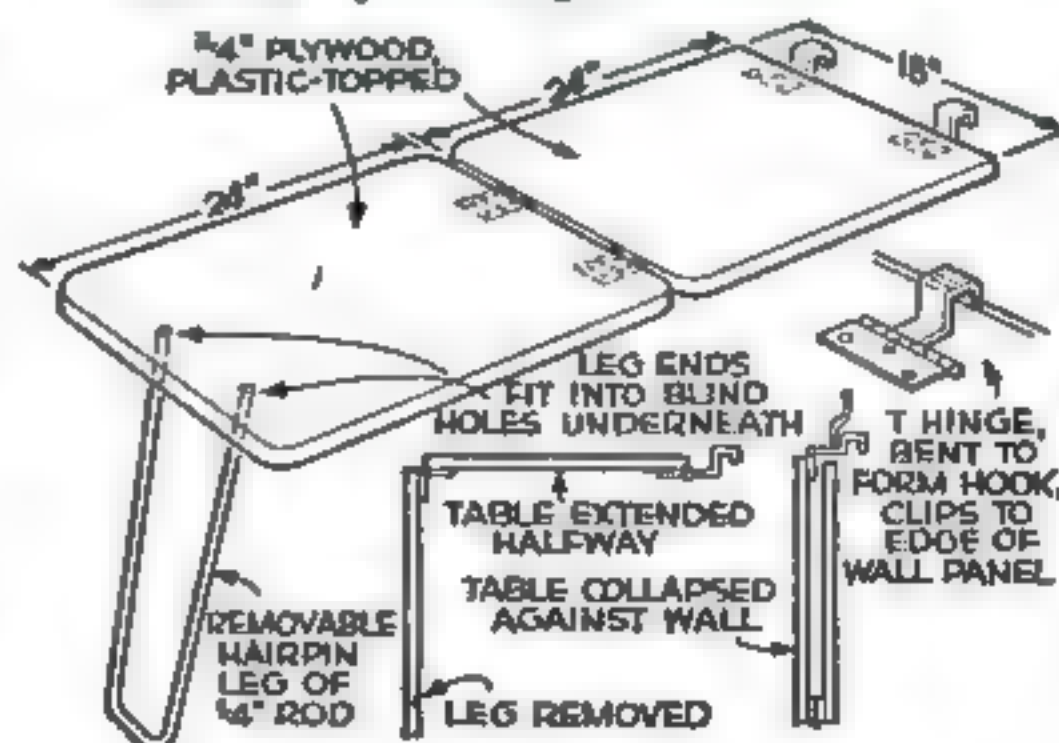
In use, the boards are laid out side by side and support two youngsters on small mattresses or in sleeping bags. When not in use, the boards are stacked out of the way at the rear.

Below the level of the boards are two facing benches that provide seats by day and turn into a double bed at night. The back of the rear bench is removable and exactly fits the space between the two benches. Drawers in the benches are pulled out slightly and the back is laid out flat on them, making a solid bed platform across the two benches. A platform behind the rear bench extends the bed farther, allowing Mom and Dad to stretch their legs out under the kids' beds.

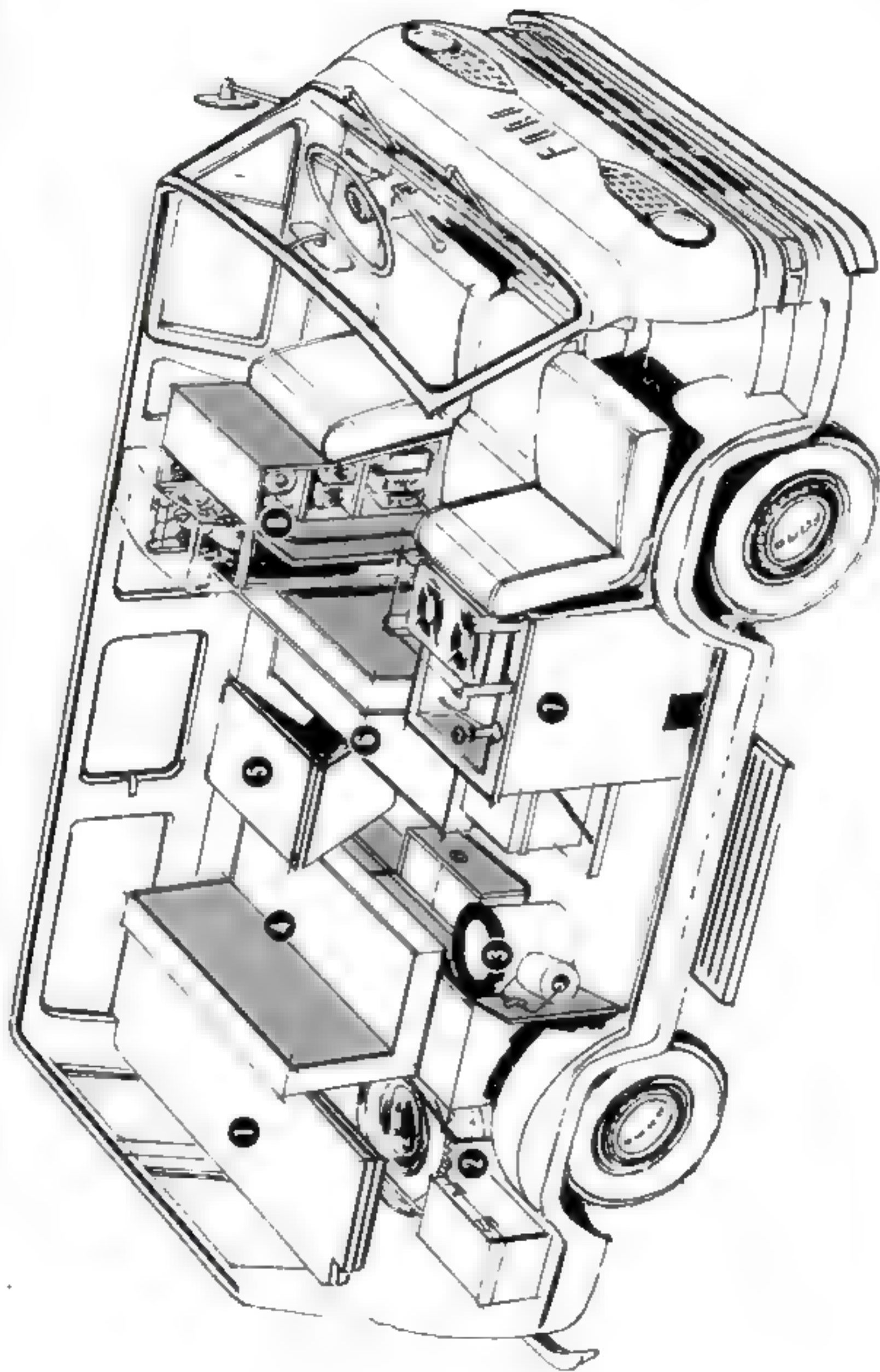
There's even room for a fifth



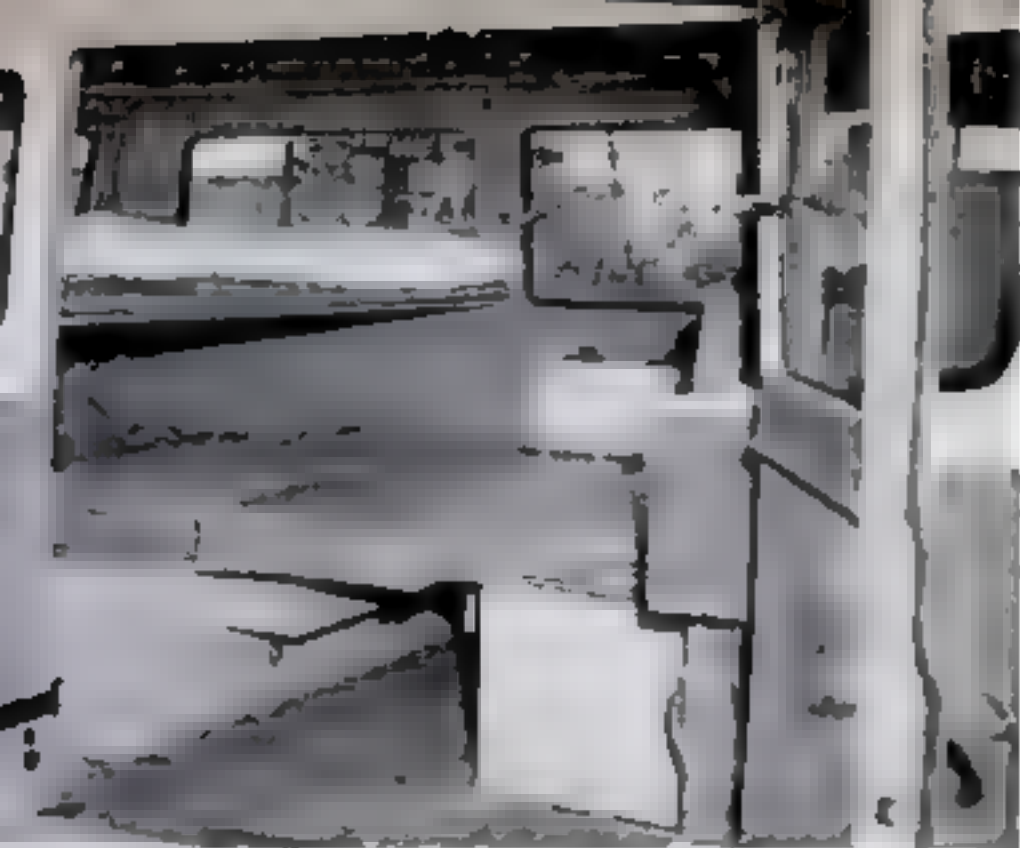
There's dining space for the whole family with this roomy arrangement. How the two-section table folds up for storage is shown below.



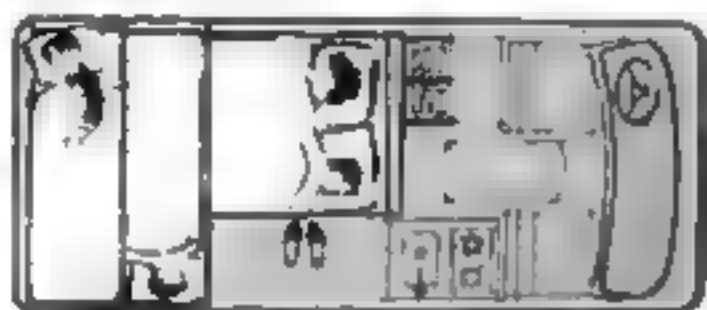
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- | | |
|--|--|
| 1. Bed supports in stored position | 5. Collapsible table |
| 2. Storage area for equipment and supplies | 6. Front bench with storage beneath |
| 3. Toilet | 7. Kitchen unit with sink, stove, icebox |
| 4. Rear bench with storage beneath | 8. Clothes closet and food cupboard |



Rigged for night use, camper sleeps two youngsters on bed boards stretched between the windows, and two grownups on benches underneath. Note how seat back, removed from rear bench, rests on partially opened drawers between the benches to form lower bed.



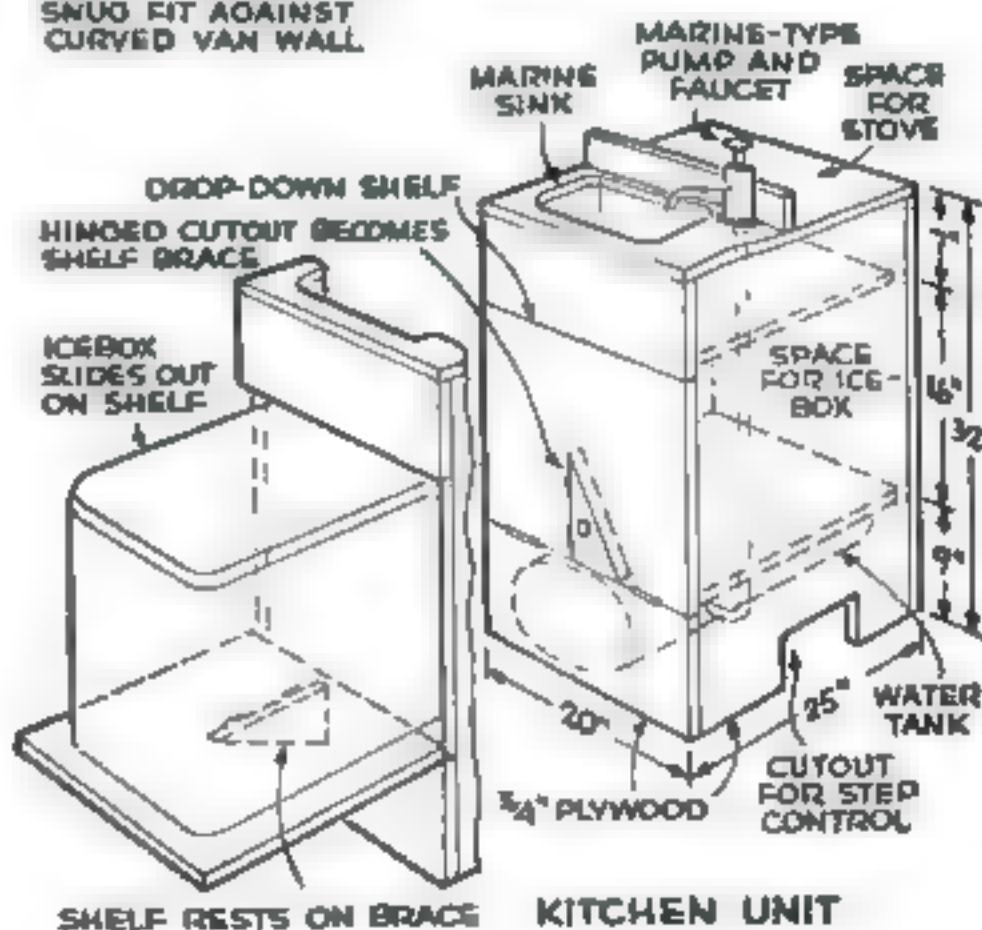
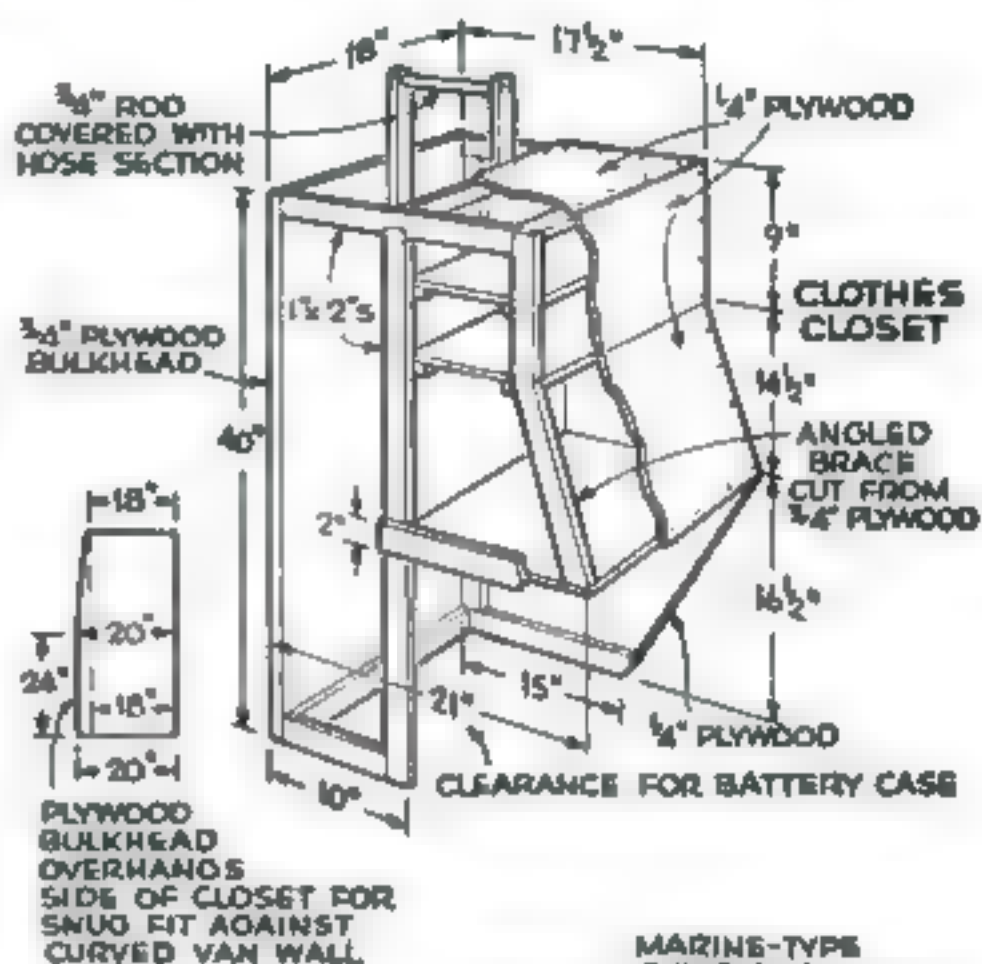
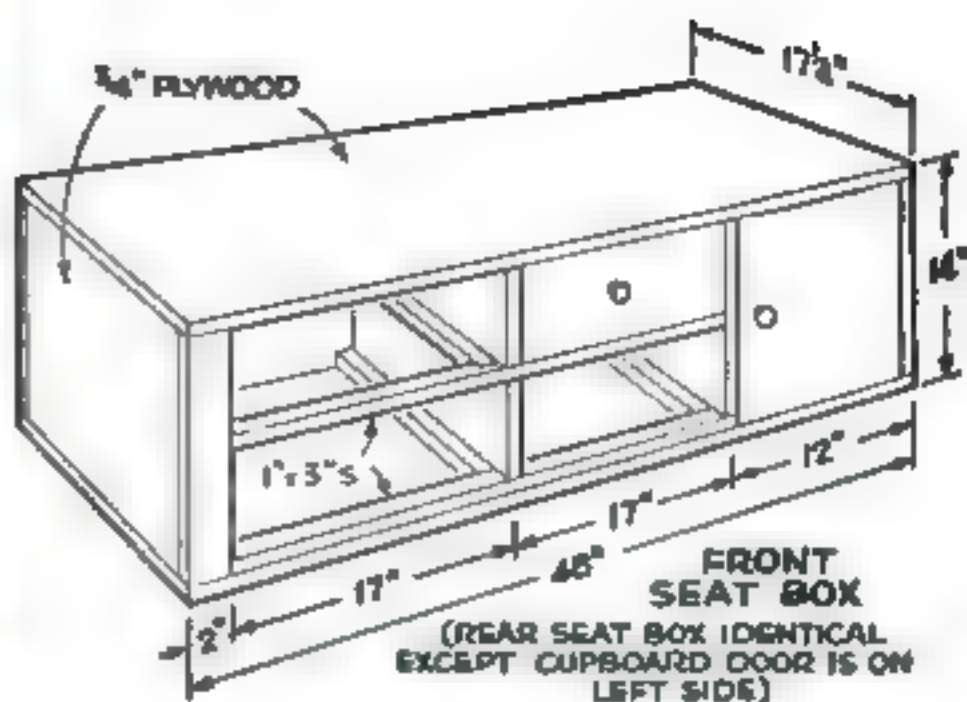
camper crosswise on the floor in the space between the two benches. And in a pinch, a sixth member of the family can bunk in the driving compartment.

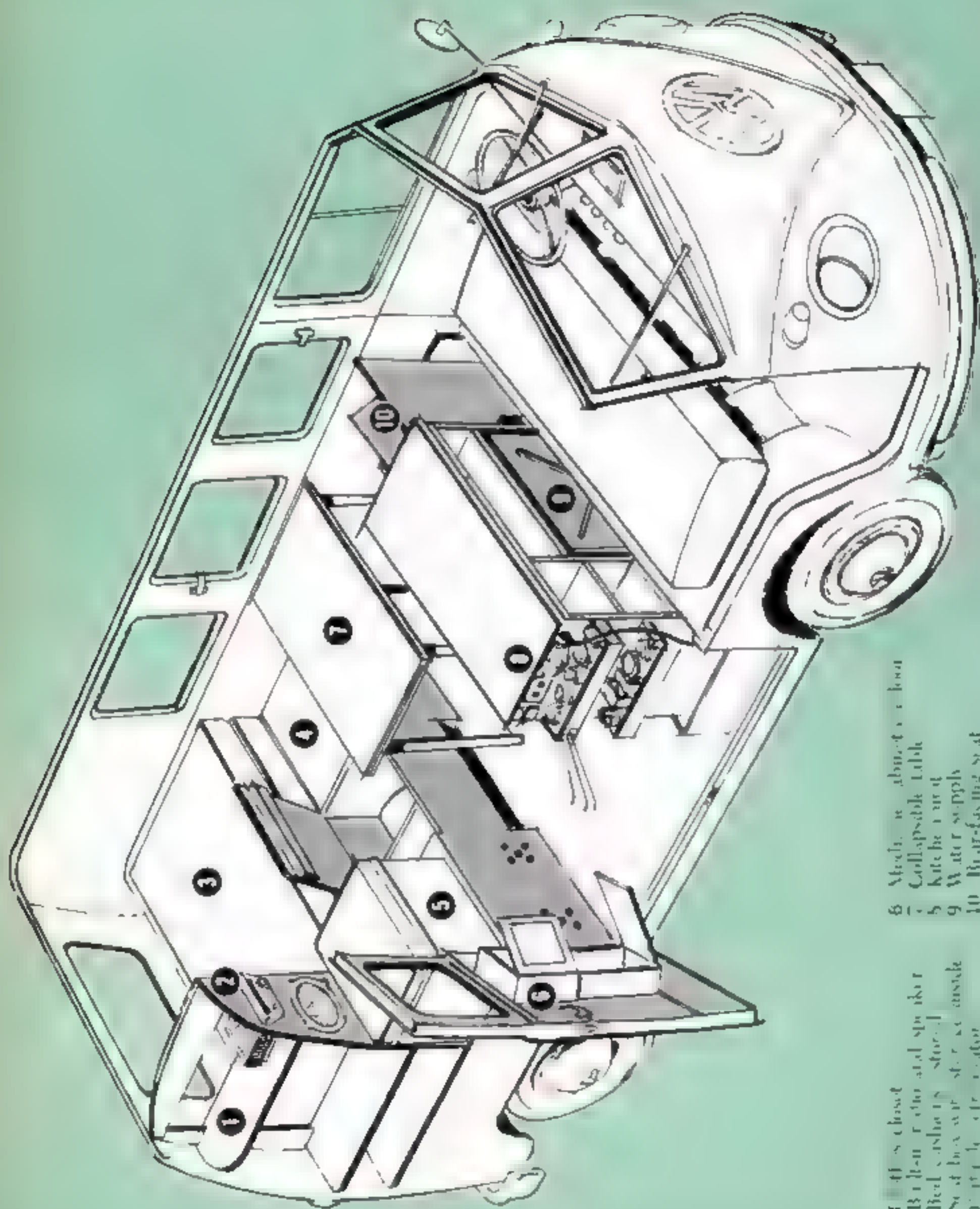
The two benches are identical in width—48"—but the rear one is slightly offset because it's centered between the two fender wheels, while the front bench sits flush against the left wall. This offset gives you space to work at the kitchen unit next to the front bench. A cupboard in the uncushioned end of the rear bench houses a small, portable toilet.

The seats and seat backs are $\frac{3}{4}$ " plywood padded with 4"-thick foam rubber and covered with vinyl upholstery fabric stapled to the back of the plywood. The rear seat back is anchored to the bench with two large barn-door-type hasps. Removing the pins from the hasps releases the seat back for use in the bed. Two bent steel rods, slipped into sockets, hold the back upright when it's used as a seat.

The kitchen unit is about as fancy as you can get in a 2'-square space. At the front, there's a small, marine-type stainless-steel sink built into the counter. At the back, there's space for a marine stove or one of the small propane camper stoves

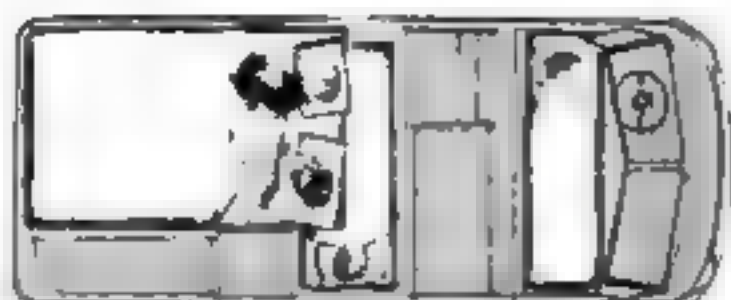
[Continued on page 199]





- | | |
|---------------------------------|----------------------|
| 1. Coffer chest | 6. Medicine cabinet |
| 2. Bathroom and speaker | 7. Collapsible table |
| 3. Bed, cushions, storage | 8. Kitchen unit |
| 4. Seat box with storage inside | 9. Water supply |
| 5. Fuel tank and motor | 10. Rear-facing seat |

How to fit out a MICROBUS as a camper



This rig sleeps four—two adults length-wise on double bed and two kids cross-wise, one on floor, other on front seat.

WHAT do you do when you want both a mobile camper and a regular station wagon for family use between vacation trips? Phil Geraci of Hyattsville, Md., solved the problem by converting a Volkswagen Microbus so it can be used either way.

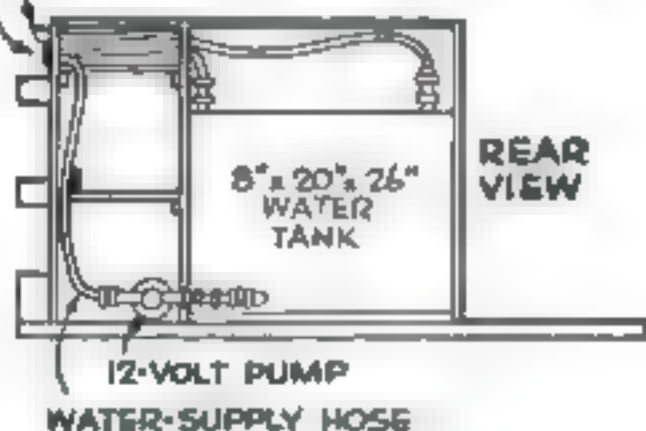
The VW's easily removed seats make the switch a snap. They lift out in a few

CONTINUED



All camping units are quickly removable. Portable kitchen, shown here, contains water tank, pump, a slide-out work table, and shelves for canned goods and utensils.

AUXILIARY FILLER WITH GARDEN-HOSE CONNECTION
FILLER HOSE WITH TRAILER-TYPE FILLER FITTING



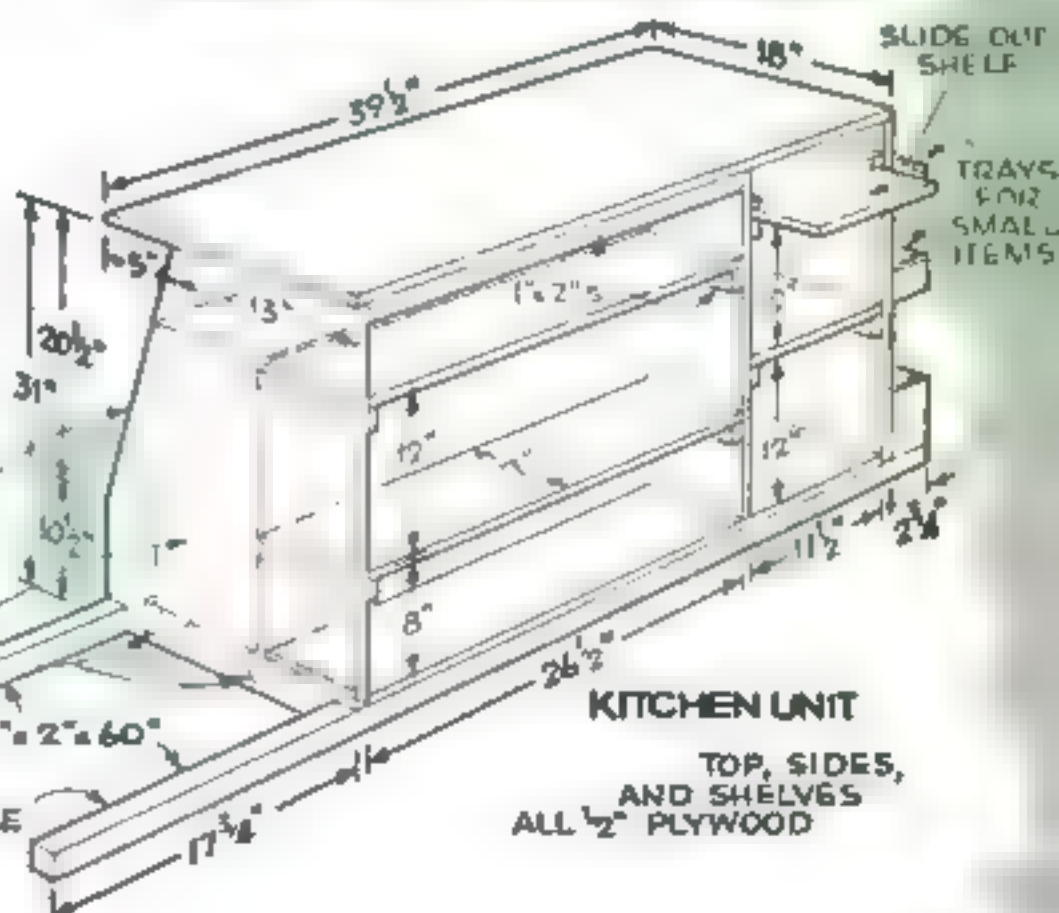
12-VOLT PUMP
WATER-SUPPLY HOSE

LEFT SIDE CUT ON SLANT TO CLEAR

WATER TANK INSIDE

TANK RESTS ON 2" x 3" S

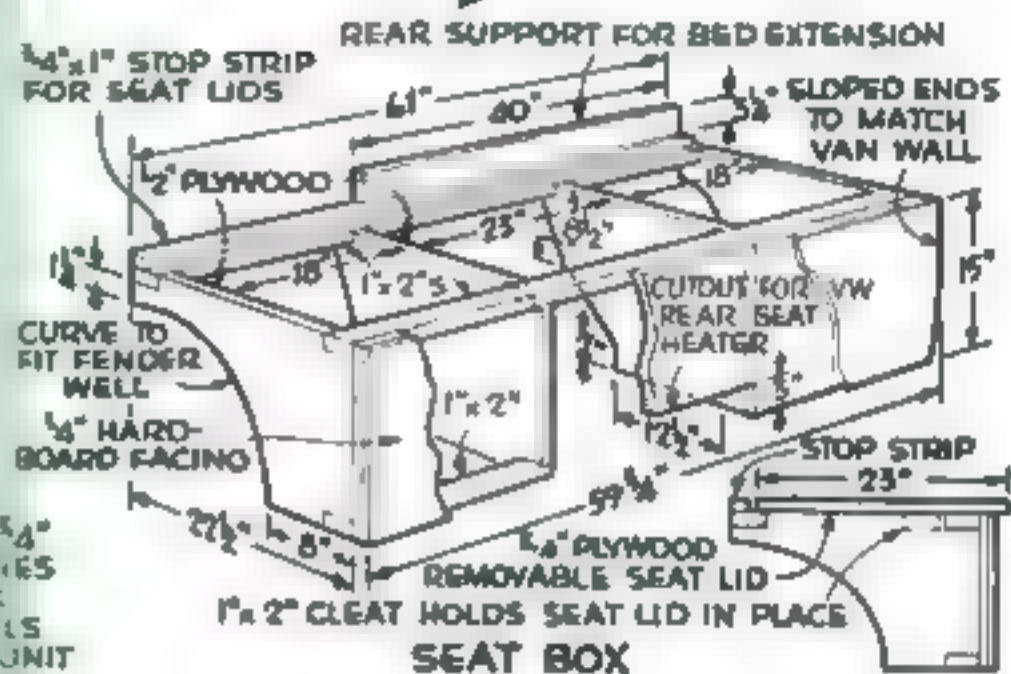
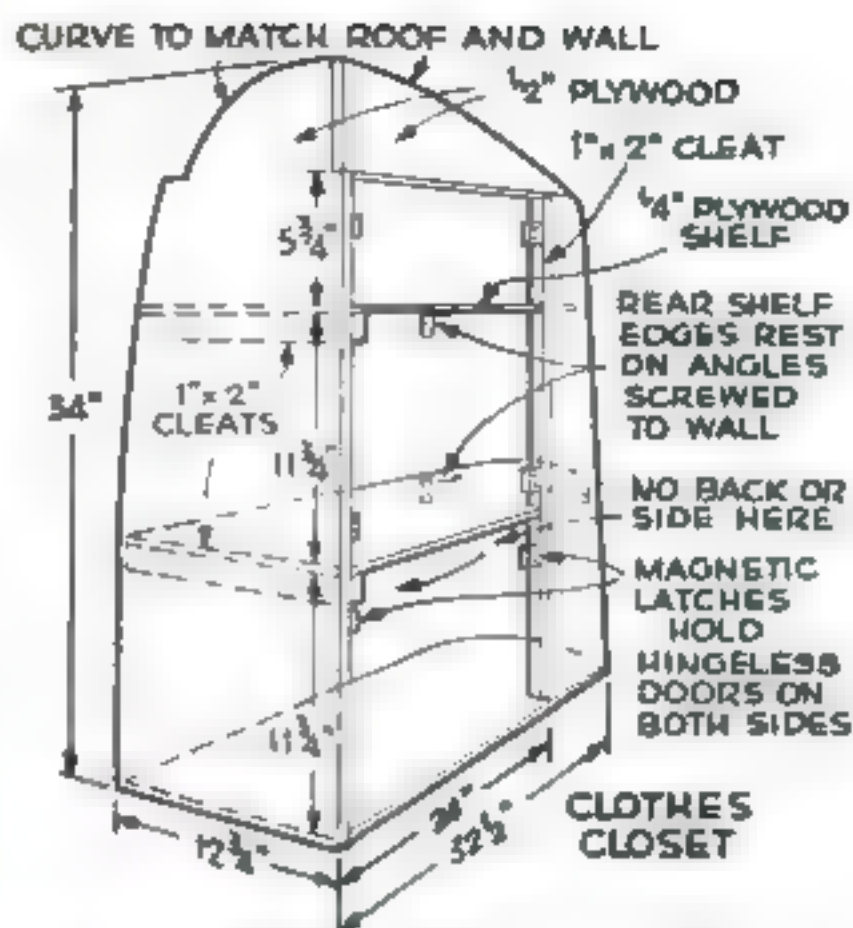
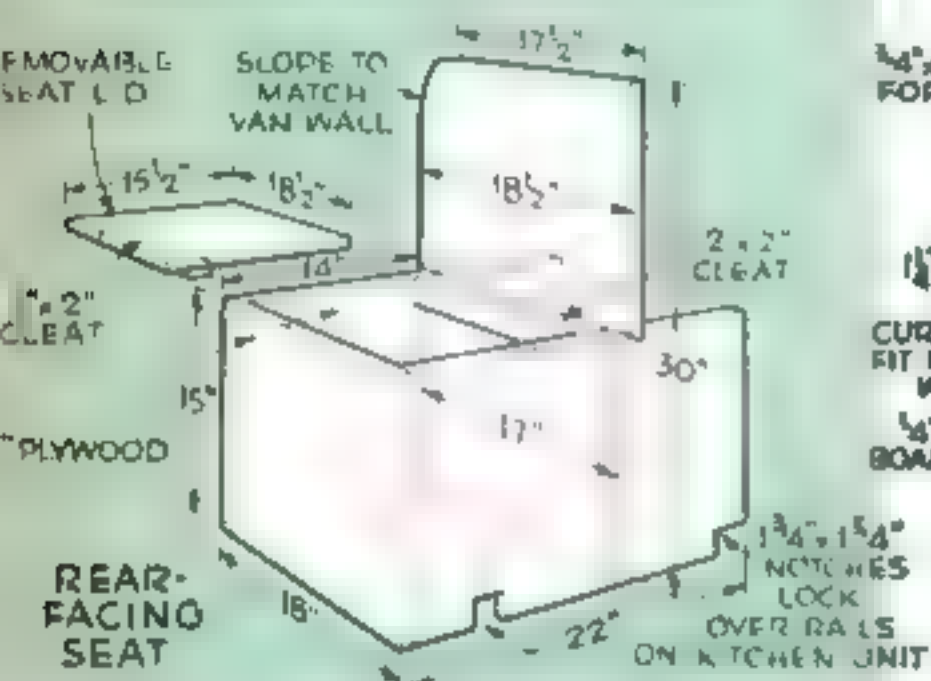
RAILS EXTEND TO LOCK SEAT IN PLACE



KITCHEN UNIT
TOP, SIDES,
AND SHELVES
ALL 1/2" PLYWOOD



Clothes closet hugs rear corner of van as if it grew there, yet lifts right out. Cardboard scraps were trimmed to match the contours of the van, then used as templates to cut the close-fitting curves.



minutes. In their place go four self-contained units that provide complete living facilities for a family of four: beds, a portable kitchen with running water, a full-width seat box that doubles as a storage bin, a smaller separate seat, and a ceiling-height clothes closet.

For a table, the Geracis use a simple piece of plywood fitted with screw-on legs. It can be set up either inside or outside depending on the weather, and can be collapsed at night by removing the legs to make room for a double bed. The bed, big enough for two grownups, consists of two 4"-thick foam-rubber cushions set up on the rear cargo deck and extending partly out over the seat box. One youngster sleeps crosswise under the raised end of the bed, while a second one bunks up in the van's driving compartment.

The furniture units are designed to hug

the van's interior contours for a trim, built-in look. Yet they lift out in minutes when it's time to convert the camper back to regular transportation. Most of them fit so snugly that no fastening is necessary. Two rails on the bottom of the kitchen unit extend across the van, wedging the unit between the walls. Notches in the bottom of the small, rear-facing front seat hook over these rails, locking the seat in place. Only the closet needs a few bolts to fasten the rear edges of its shelves to angle brackets screwed to the van's walls.

To run the camper's electrical appliances, Geraci rigged up the unique power-supply system shown on the facing page. It operates, among other things, a complete hi-fi system mounted in the clothes closet. The same supply also runs a 12-volt water pump mounted in the kitchen unit. This pumps

[Continued on page 206]

How to get more electricity for a camper's accessories

MOBILE campers have one bad habit: They eat up electric power in huge gulps. There are lights, fans, refrigerators, pumps, radios, electric shavers, and probably a woman's hair dryer. For Phil Geraci, who built the VW camper shown here, there was an added problem: The VW uses a six-volt system that won't feed the new 12-volt accessories. The Geracis also wished they could take along household appliances requiring 110 volts.

Geraci's idea: Why not install a separate power supply that would provide any type of electricity desired? The rig he devised can be used in any mobile camper to provide almost unlimited electric power.

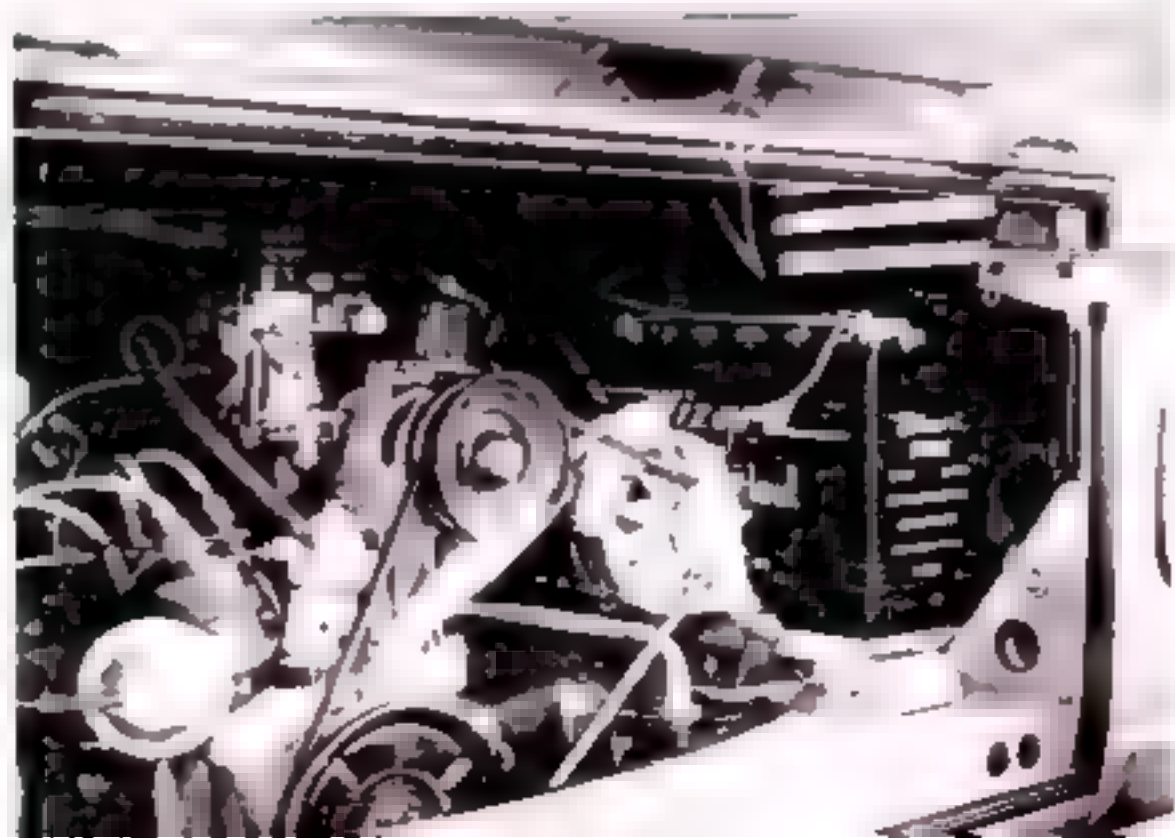
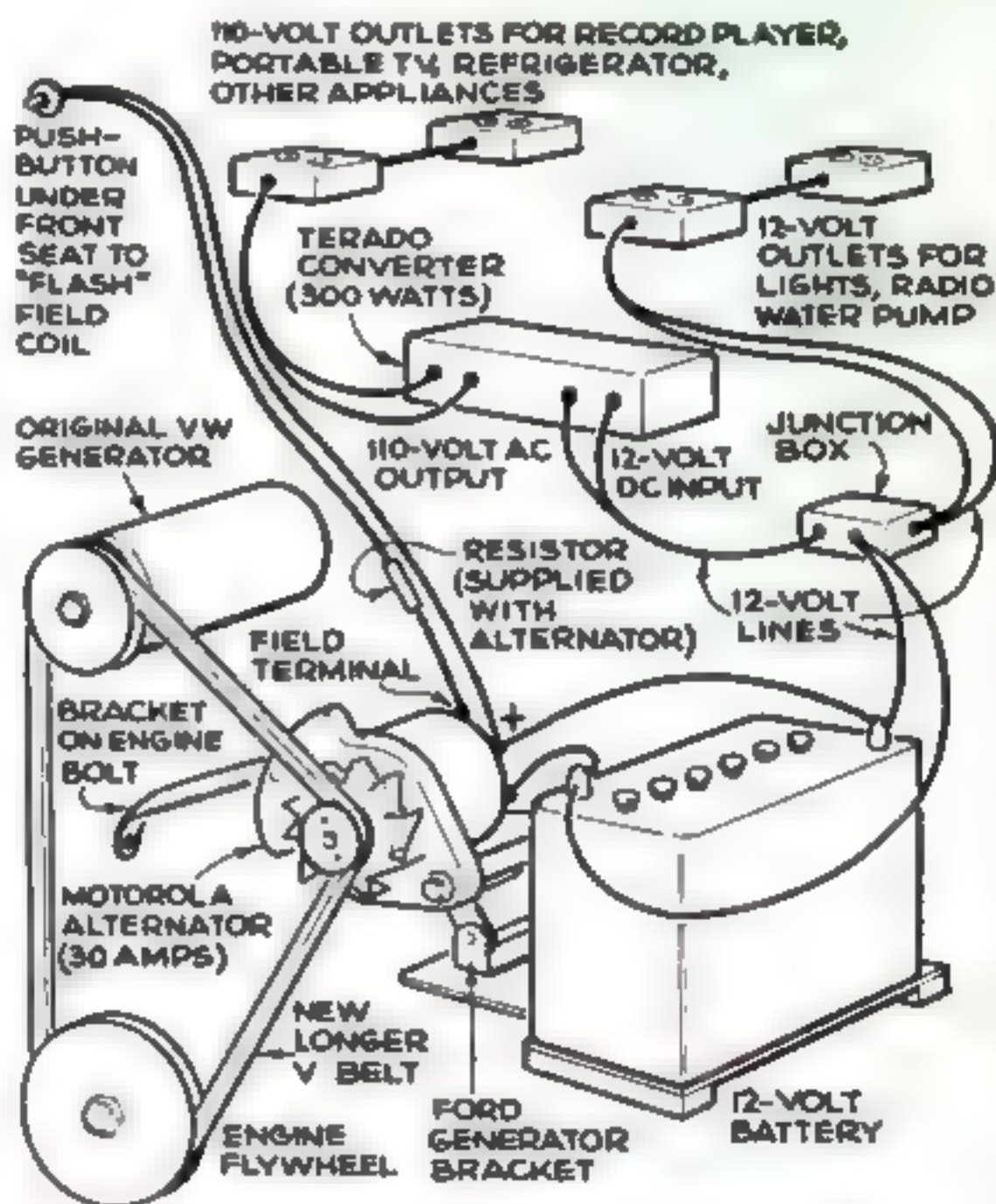
The answer proved to be one of the new alternators that produce electricity even at a slow engine idle. Geraci chose a 30-amp Motorola and mounted it next to the engine so it's driven by the same belt that drives the VW generator. A new, longer belt did the trick here.

The alternator feeds a new 12-volt battery, keeping it charged. One pair of leads runs from the battery to a string of outlets that handle all of the 12-volt appliances. A second pair of leads runs to a 300-watt Terado converter that changes the 12-volt DC current into 110 volts AC. This, in turn, feeds a second string of outlets that handle all of the 110-volt appliances.

Result: Plug in anything you want—even the home TV set—and there's plenty of power to run it. One daytime charge provides all-evening power with the engine shut off. With the engine running, you can draw the full 30 amps directly from the alternator for high-draw equipment such as power tools.

The alternator requires a momentary shot of current to

magnetize the field and start the charging. For this, Geraci rigged up a pushbutton under the front seat. The alternator itself fits conveniently into a Ford generator bracket bolted to the chassis. The original six-volt system is left intact to take care of the van's own needs. With this setup, there's no risk of running down the engine's battery when you want to stay up late to watch television.



PIGGYBACK CAMPERS

a kit cuts the cost



Do-it yourself camper kit fits many popular pickups. Inside can be finished with bunks and plywood. It's made by MacDonald Camper Kit Co., El Monte, Calif.



Aluminum sheathing is rolled down over pre-finished metal frame and trimmed to size. Manufacturer claims two men using ordinary tools can assemble the camper in one day.

THE once-lowly truck-mounted camper is getting the glamour treatment. More room, fancy interior trim, and more efficient kitchen and bathroom facilities are the order of the day.

Advantages over house trailers? Plenty. Camper-equipped vehicles handle better on the road. Your wife can cook while you drive (most states forbid riders in trailers while they're in motion). You can travel on roads that restrict trailers. And campers are far cheaper than motor homes.

Two types of campers are available: slip-on and chassis-mounted. The former can be removed when you need the pickup for everyday duties. But the permanently mounted units seem to be more popular. They're roomier, and offer bathroom facilities not usually found in slip-ons.

If you're on a tight budget, build your own camper. You can buy the kit pictured on this page for as little as \$185.

There are also many ready-built units to choose from. One of the most unusual has a glass rear wall with a sliding door. It gives an open,

WHY BUY AN ORDINARY PANEL WHEN YOU CAN GET...



Winner of the
Spotlight Award
by Popular Science
Monthly

More loadspace...more loading ease...

Econoline offers 204 cu. ft. of loadspace; a low floor flat from front to rear ...no rear engine hump to hamper load-

ing. And big 4-ft. doors at rear and sides (left side optional) put all the load within easy reach for fast unloading!



More driving ease..

Huge windshield gives superb visibility! Over-all length is 2 ft. less for quicker turning, easier handling.

More miles per gallon...

30% more! Certified tests show Ford's Econoline Van can go as far on 3 gallons of gas as old-style panels go on 4!



FOR \$126 to \$394 LESS!*

Econoline saves work, saves time, saves trips, yet is priced \$126 to \$394 less than old-style 1/2-ton panels! Savings in operating costs can total \$100 yearly!

*Based on comparison of manufacturers' suggested retail prices for standard equipped vehicles.

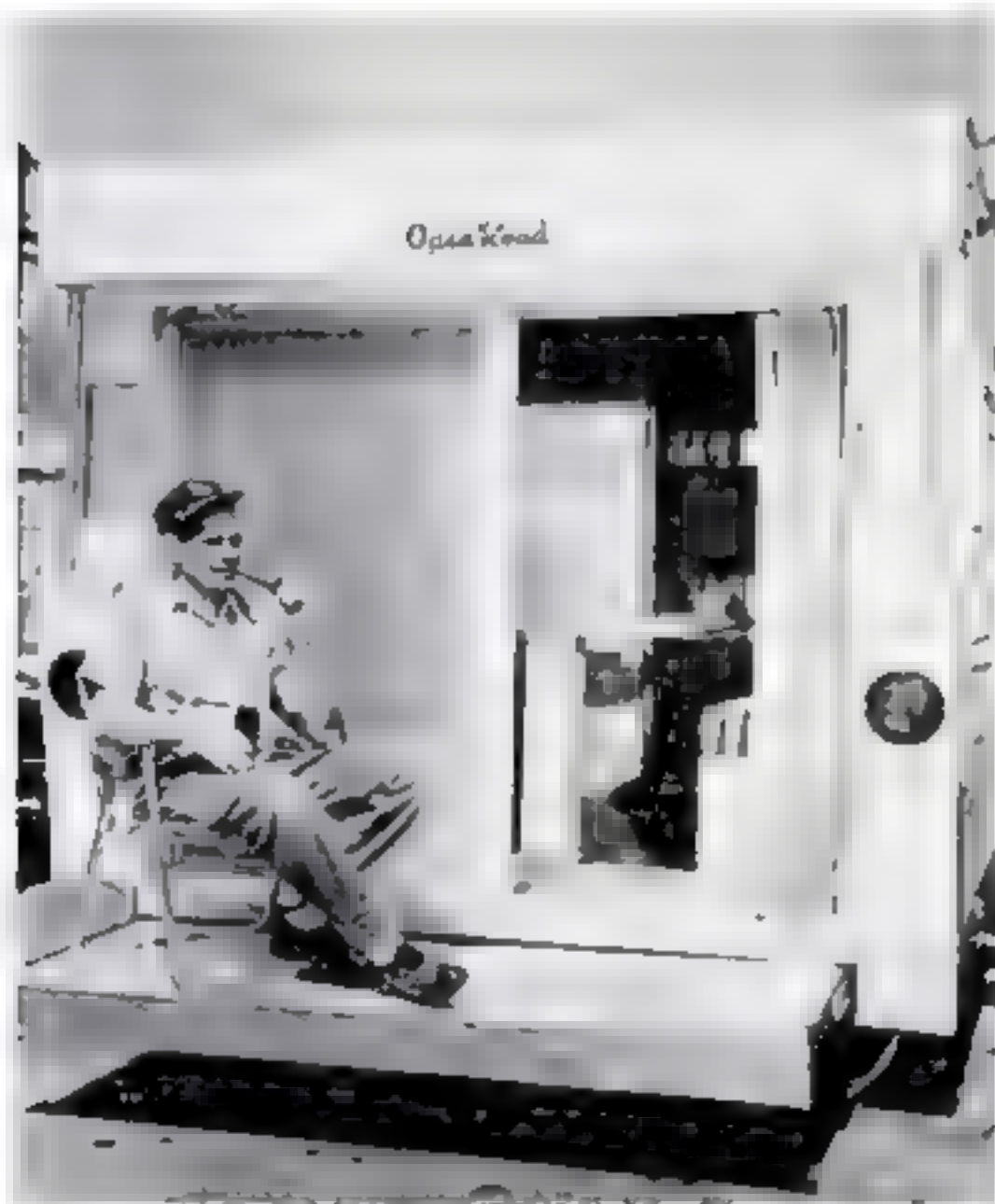
FOR 60 YEARS THE SYMBOL OF DEPENDABLE PRODUCTS

 MOTOR COMPANY

1963 FORD ECONOLINE VAN

PIGGYBACK CAMPERS

you can
even buy one with
a back porch



Slide out the 3'-by-6' porch on the Robin Bel-Air shown above and relax. Rollers are cadmium-plated to prevent corrosion. Rear wall is safety glass. Approximate price: \$3,000.

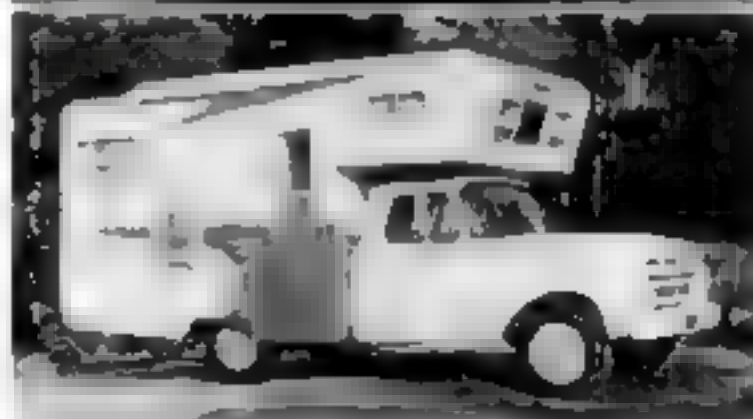
airy feeling, says Robin Mfg. Co., Culver City, Calif. Their Bel-Air unit is 10½' long, 7½' wide. It slips on a ½-ton truck or bolts to a trailer chassis. It has a full bathroom plus outlets for appliances when 110-volt current is available.

The Sportster Challenger (\$3,995) is the hottest model made by Roll-Along of South El Monte, Calif. Price includes frame lengthening. There's a walk-through opening between cab and camper, and the cab has swivel seats. The 22'-long, 8'-wide unit mounts permanently on a ½-ton truck. It sleeps four, and has wood paneling, flush toilet, six-cubic-foot refrigerator, and oven.

The wheelbases of most ½-ton trucks must be extended about a foot to accommodate the 12' Safari. This camper also comes in 10' and 14' lengths—the latter requiring wheelbase lengthening of about 3'. All are 7½' wide.

Features include a side entrance, butane-electric refrigerator, and sleeping accommodations for four. Prices range from \$1,795 to \$1,995, plus \$445 for a full bathroom with shower and hot water. The manufacturer: Coons Custom Coach of Pomona, Calif.

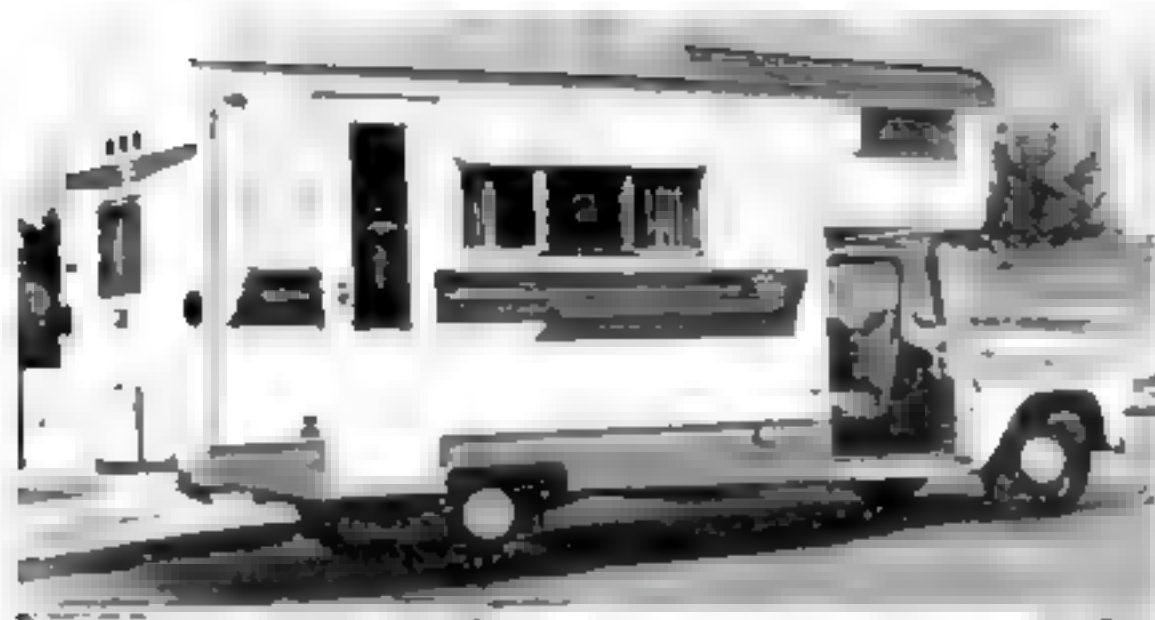
Looking for a slip-on unit for a half-ton truck? Tear Drop of South El Monte makes one. Their



Frame must be modified to accept 1,500-pound Coons Safari camper. A double bed perches over the truck cab; dinette divans in the rear of the camper convert into second double bed.



Wind resistance is reduced by V-shaped front window of McNamee's Kamp King. Foam-rubber insulation—claimed to keep interior temperatures comfortable more efficiently than other materials—is new. Prices start at \$1,545.



Roll-along camper has swivel seats. Passageway to cab is closed with an accordion-type door. A six-cubic-foot gas-electric refrigerator and safety-glass windows are standard equipment. A full-width tubular container below the rear bumper conveniently holds the sewer hose for use in trailer parks. \$3,995.

big model is an 8½'-wide unit that sleeps four to six. An insulated icebox and a butane stove are standard equipment. Price: \$1,295.

Most slip-ons don't have toilets. However, the Super De Luxe Kamp King, made by McNamee Coach Corp. of South El Monte, has one. Though the firm makes campers up to 10½' in basic length, their 8½' model (12½' including over-cab section) is the big favorite. All fit ½-ton trucks.

Both Montgomery Ward and Sears sell knocked-down campers to fit most pickups. Prices start at \$249 and \$364 respectively, less bunks and curtains. Installation is claimed to take two hours.

The smallest, cheapest camper? It's made by Huntsman Co., Pomona, Calif. The price of the louvered-windowed unit has been reduced to \$220. It can be mounted even on compact pickups. But you have to outfit the interior yourself. ■ ■

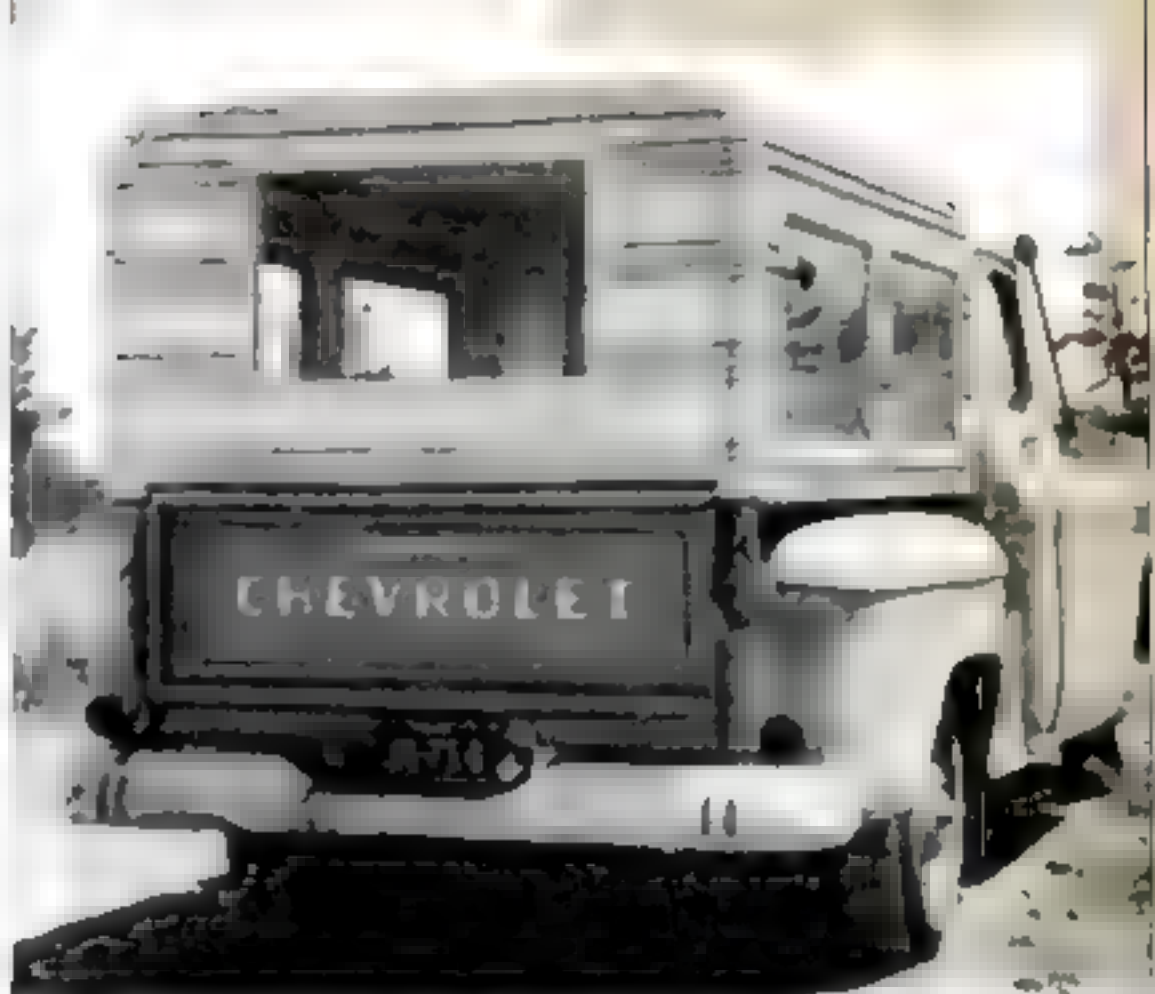


Foam-padded beds mount in tented "wings" at sides of Scout Camper by International Harvester. Deluxe model (\$1,850, factory installed)

has a dinette set, stand-up galley, and a screened chemical toilet that retracts into the wall. Standard, stripped-down unit costs \$960 installed.

A PIGGYBACK CAMPER

you can
make yourself



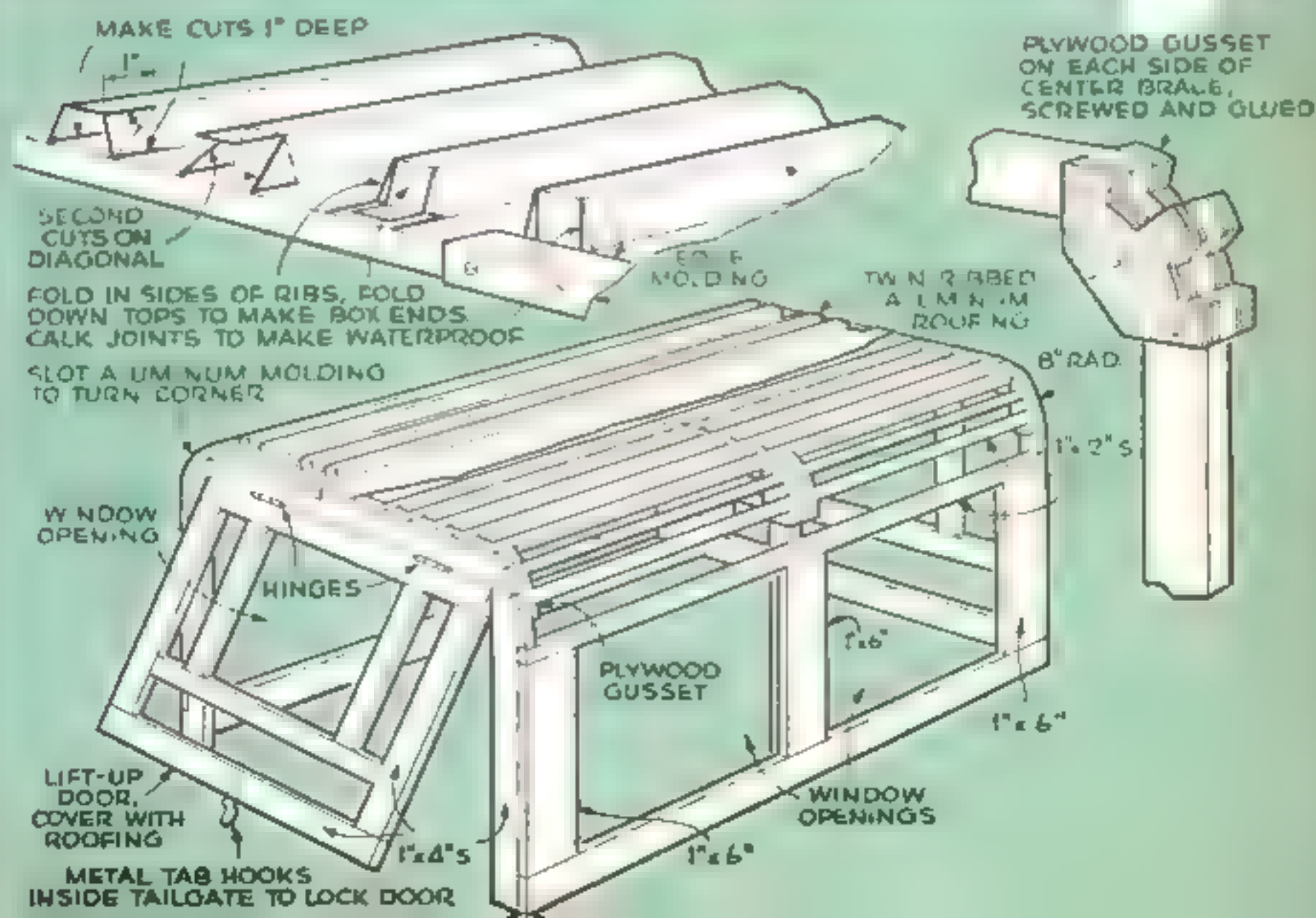
FOR simplicity, this homemade canopy for a pickup takes first prize. Made of twin-ribbed aluminum roofing over a light wood frame, it cost its builder, Earl Cochran of Colorado Springs, just \$50. Inside, there's space for one folding cot or two sleeping bags, plus a stove, water jug, food, and other supplies.

Any metal roofing could be used, but the twin-ribbed type is especially handsome. The only tricky part is finishing off the edges. Note in the drawing below how the ribs are cut and bent to form neat, closed-in ends. These are fastened with aluminum-angle strips screwed down over

all corner joints. The roofing needs no additional fastening, thus avoiding nailholes at intermediate points that might cause leaks.

The canopy is bolted to the truck body with metal angles. Its size will depend on the type of pickup you have. Cochran's required three 4'-by-7' sheets of roofing for the top and sides and one 4'-by-10' sheet for the ends. Total cost: about \$20.

Cochran used small stock windows that come complete with glass and sash. The fixed-glass type are cheapest, but for ventilation you can also get combination units that include screens.



CAR-TOP SLEEPERS

one you
can build

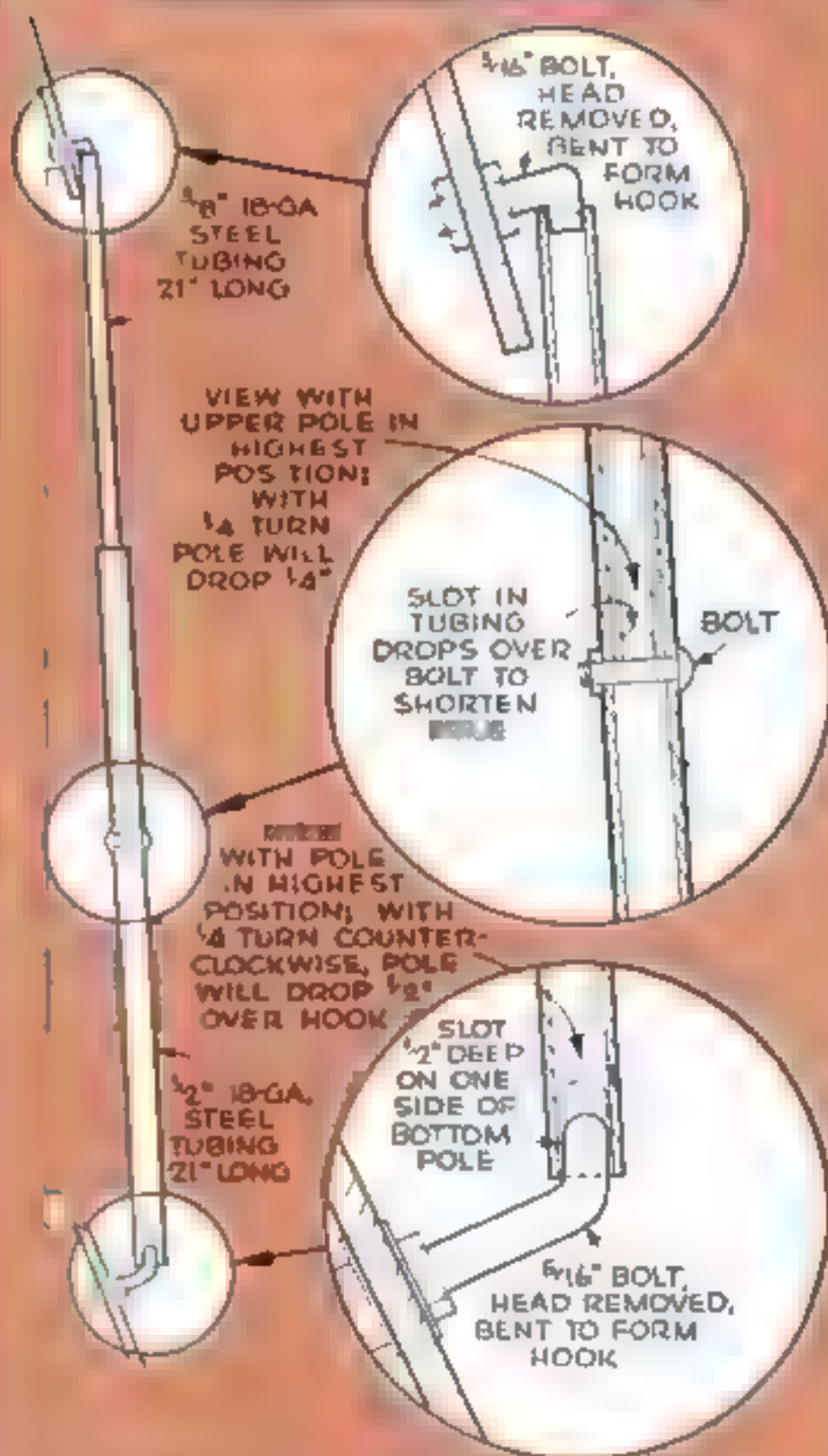
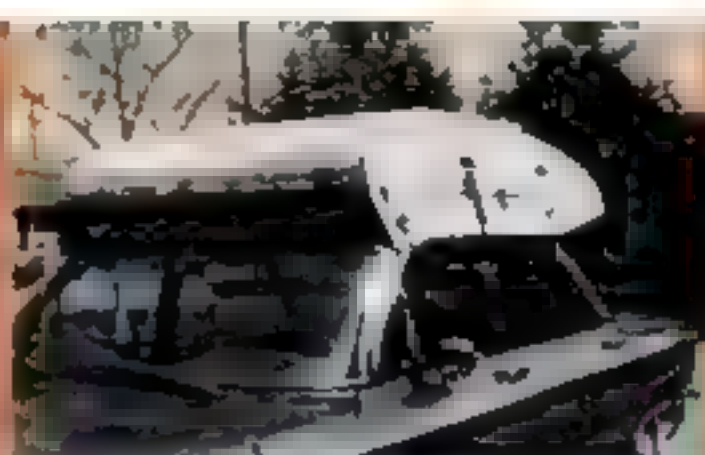
BY DAY, all that shows on the roof of your car is a slim, streamlined box with the graceful teardrop shape of an airplane wing. At night, you prop up the box lid and—presto—there's a weather-tight canvas enclosure large enough to house a double bunk, all made up and ready for sleeping.

The big charm of a roof-top rig is that you can fit one to any car and take it off and store it between trips. With Mom and Dad topside and two kids on the car's regular seats, this simple arrangement can sleep a family of four.

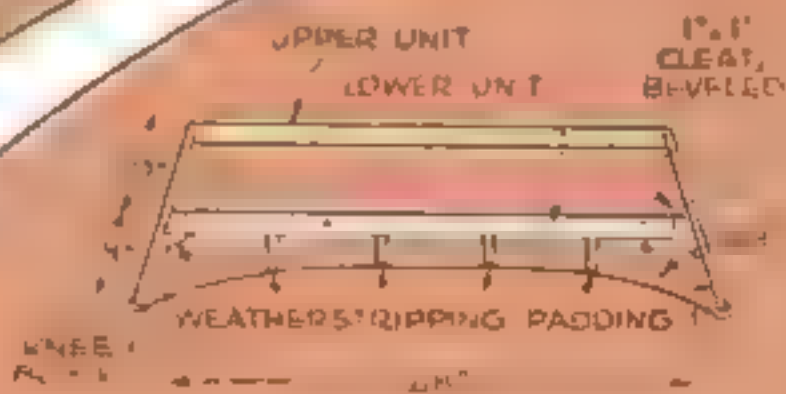
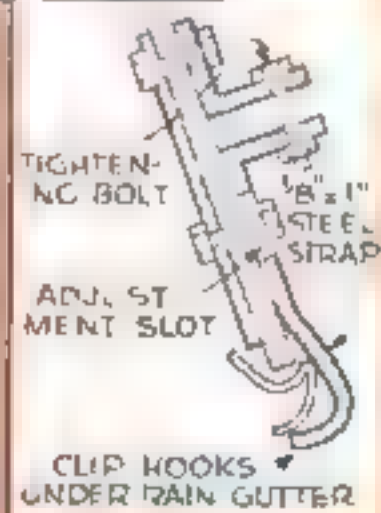
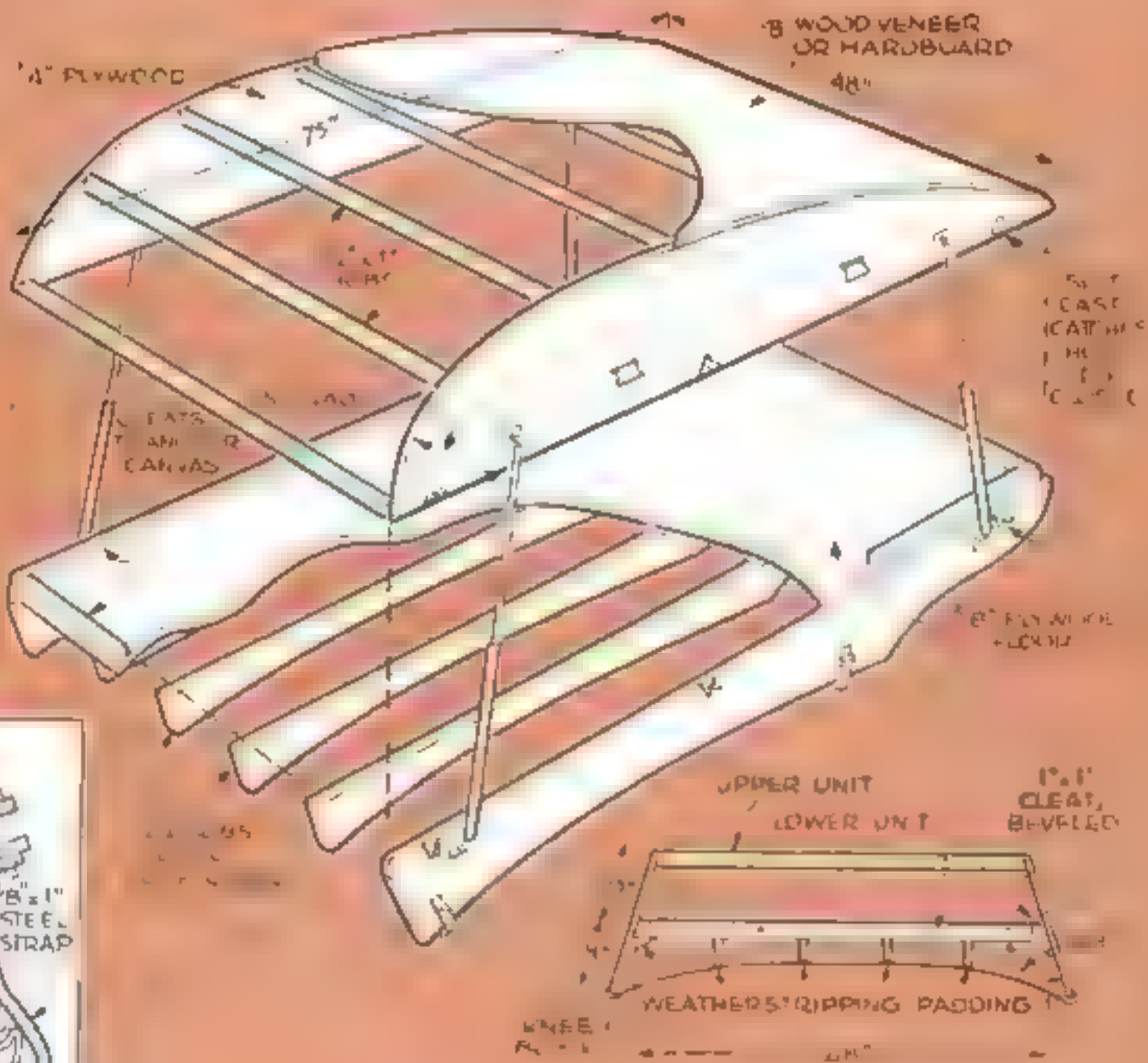
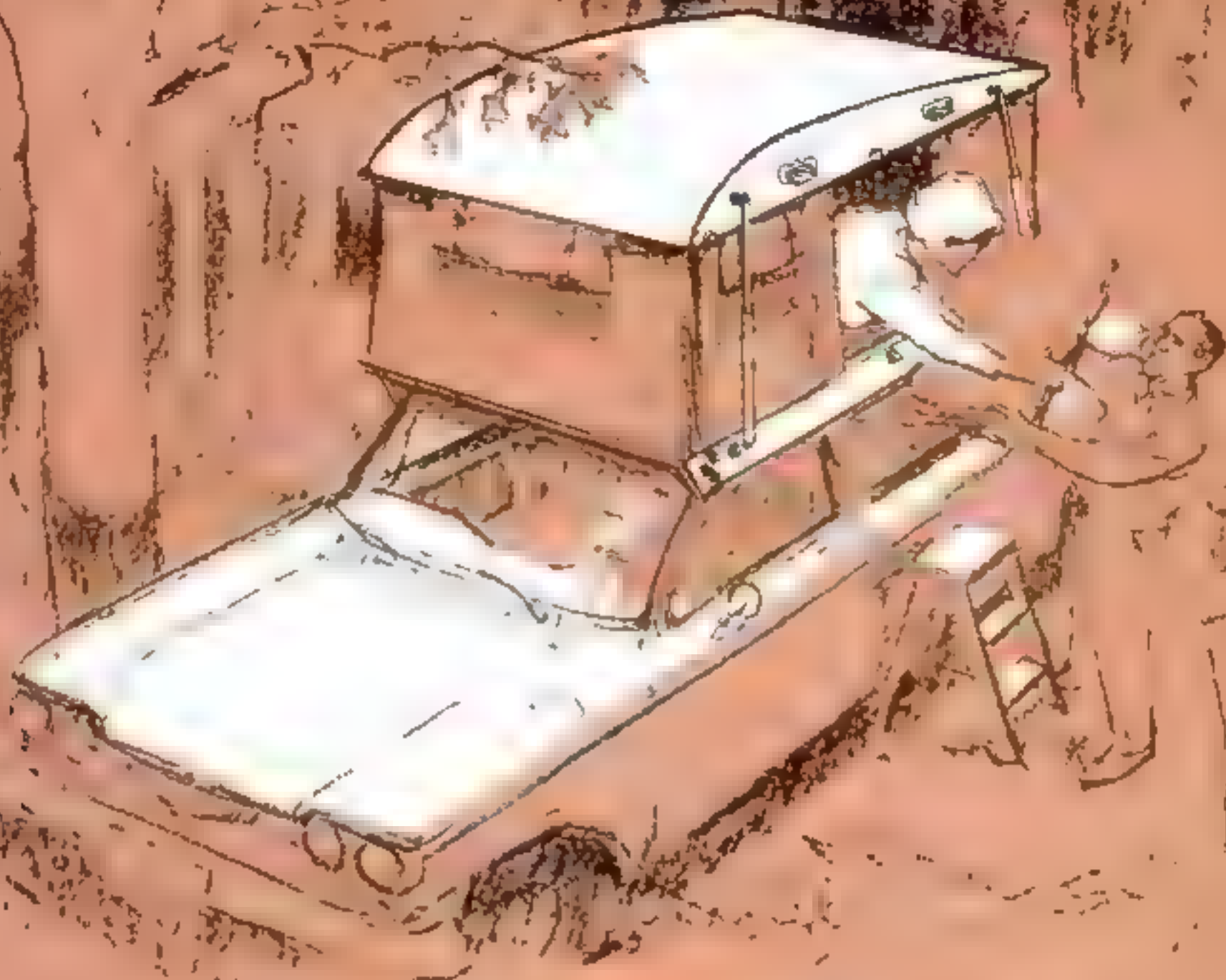
Car-top sleepers are available commercially in several types, but you can also make one yourself. The rig shown here, built by E. D. Lindblad of Norwalk, Calif., cost less than \$50. The bottom half is just a plywood platform supported on ribs shaped to the roof's contours. Two outer side rails rest directly on the rain gutters, taking most of the weight off the roof proper. With the top removed completely, the platform can double as a general-purpose load carrier.

Exact dimensions will depend on the car, but even a small roof can support a full-length bed if you let the rear end overhang slightly, as here. A length of 75" takes a standard-size air mattress comfortably, and you can leave the mattress inflated when the top is closed. Clips, made of steel strap, anchor the sleeper to the roof

[Continued on page 204]



Notches filed in ends of telescoping tubes drop over pins, letting tubes retract slightly so you slip them over lower hooks. A quarter turn spreads tubes to tension canvas.



STATION-WAGON TENTS

5 they
hitch a home
to your tailgate



You add 81 square feet of extra living space with this 9-by-9' extension (left). This and other Montgomery Ward models all have sewn-in canvas floors, are 7' high at the peak. Frame is free-standing, does not depend on car for support. Connecting hood from tailgate to tent is held in place with elastic ties.

For quickie stops, you can add a sleeping porch

If you don't need a full-size tent, here's a simple canvas enclosure that adds usable living space inside the wagon itself. As shown at right, it slips quickly over the opened rear end, turning your tailgate into a cozy bedroom. You can sleep in the rear

without having to collapse the wagon's seats.

A hooded mosquito-net window gives bug-free ventilation even in a downpour. Karpak Co., Roanoke Bldg. Minneapolis, sells the enclosure for \$26.95.

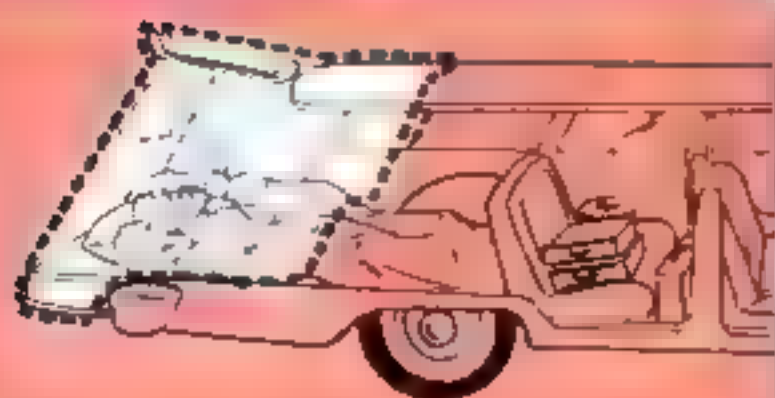


EVER wish you could camp right in your station wagon, yet have plenty of space for eating and sleeping in comfort? Here's a new breed of camp tents designed for just that. Back your wagon into a hooded opening on one side and you have a snug-fitting extension big enough to sleep from four to six persons.

There's no unloading your wagon at each night's stop—food, cooking equipment, and bedding are brought right into the tent intact. Your tailgate becomes a handy table. When you want to run into town for supplies, you just roll the wagon away and close the opening with a flap.

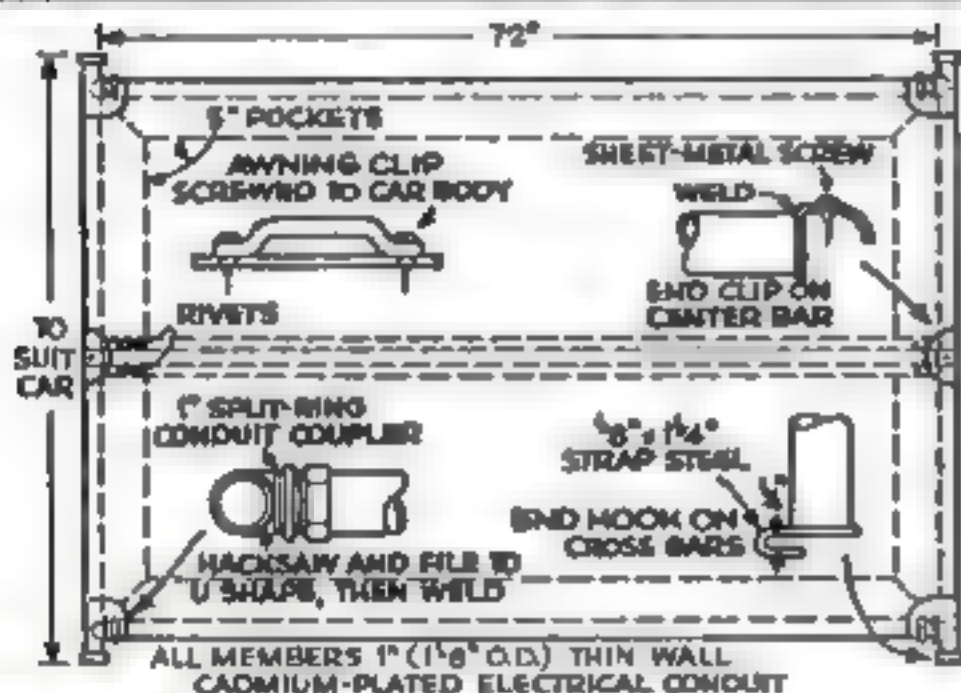
The tents come in two styles, the teepee type above and the straight-sided one on the facing page. Another innovation: The aluminum-tube frame goes on the outside, and the tent hangs below it. This makes setting up a breeze, ends fumbling inside with poles, and prolongs tent life by eliminating abrasion against the frame.

The tents shown are available from Montgomery Ward. Prices range from \$87.50 for a 7'-by-9' size to \$109.50 for a big 11'-square model. Similar tents are sold by Sears, Roebuck, Ames Harris Neville Co., and others. You can also get conventional tents with inside-out frames.





UPPER BERTH for a station wagon



Double bed hooks quickly into awning clips fastened to the wagon's window molding with self-tapping screws. If this puts the bed too low to clear the front seat, shift it farther back so it mounts behind the seat.

SLEEPING in a station wagon is a fine way to camp, but often it's done the hard way. You unload all your gear each night to make bed space, then repack it each dawn.

This didn't make sense to E. F. Lindsley of Troy Center, Wis., so he fashioned an upper berth out of a simple canvas rack. The berth sleeps two adults comfortably without disturbing gear stowed beneath it. On the road, it rolls up neatly out of the way.

Electrical conduit makes a lightweight frame for the canvas. The two crossbars have clips welded at the ends. These hook into awning clips screwed to the wagon's metal window molding. On Lindsley's Jeep, the windows are high enough to let the bed extend forward over the front seat. On lower wagons, the bed can be located just behind the seat.

Standard conduit couplings welded to the crossbars make it easy to assemble the frame. To collapse the bed, the three lengthwise poles are detached and slipped out of the canvas pockets, and the canvas is rolled up.



And here are
**Two
 Extra
 Ways
 to
 Vacation
 on
 Wheels**

TRAVEL TRAILERS

Sales of the ever-popular travel trailer have almost doubled in the past five years. Last year alone, more than 58,000 were made. Their big appeal: They give you roomy, comfortable living quarters, yet can be unhitched in minutes. Average price is about \$1,800. Typical of the many new models out this year is the trim Trotwood above.

MOTOR HOMES

One of the newest trends in on-the-road camping is the luxurious motor home—literally a house on wheels. Road-tested by PS in January [see "Coast to Coast in a Dodge Motor Home"], this type of camper offers full living facilities for four or five.

Shown here are two of the latest, the Traville (top) and Clark Equipment Co.'s Cortez (bottom). Prices are \$7,980 for the Traville and \$7,985 for the Cortez.

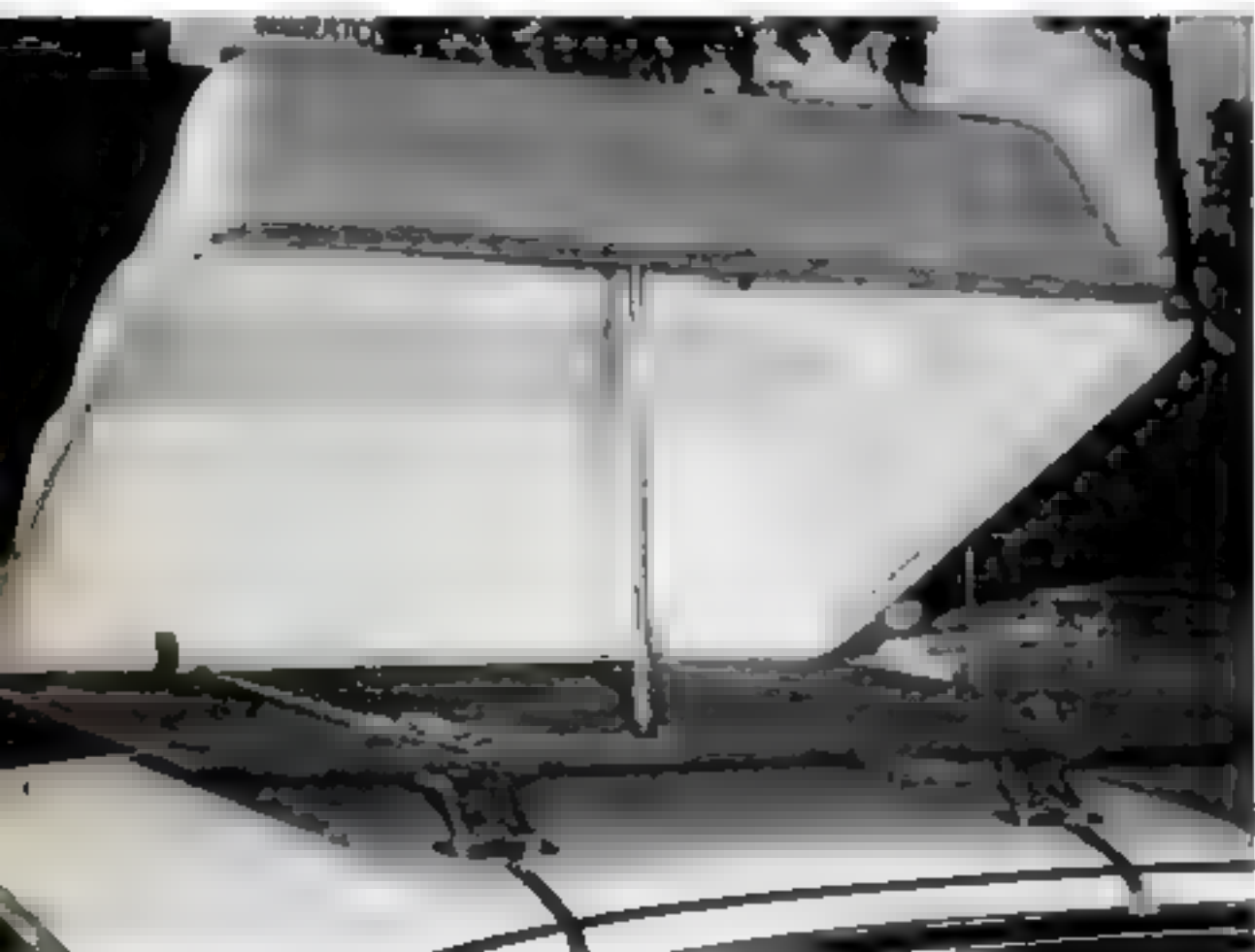




A lockable zipper protects your camping supplies in this weathertight enclosure. A collapsible inner frame lets you fold the carrier flat for storage. Market Forge Co., 35 Carvey St. Everett, Mass., makes three sizes for about \$37 to \$50



This jumbo-size carrier is big enough to double as an upper berth for two. It comes in four lengths from 4' to 90". Prices range from \$48 to \$125 from Carter Mfg. Co., 1235 S. E. Division St., Portland, Ore. Luggage covers are extra.



CAR-TOP CARRIERS

they add a trunkful of space on the roof

OFTEN, although you don't need a fully outfitted camper, you do need extra stowage space to pack along all the gear that a vacation trip calls for. One good way to double your trunk space is to put your roof to work.

Modern car-top carriers are designed to do just this. They not only anchor a load snugly topside, but many newer types also provide a weather-tight enclosure to keep your supplies dry and protected.

Most auto makers supply roof carriers made especially to fit their own cars—a point that may not be generally known. Independent makers also provide a wide variety to choose from. Shown here and on the next page are some of the types available for your camping needs.

Made of rigid fiber-glass, this hinged canopy is designed for rugged use. It's 4' wide by 54" long, giving 20 cubic feet of stowage. A seal around the edge keeps out rain and dust. With the canopy removed, the rack serves as a flatbed hauler. It's made by La-Cal Automotive Co., 701 Gibbons St., Los Angeles. Price is \$98.50.

This bustle-back carrier, made especially for the VW, minimizes mileage-robbing wind resistance, is said to improve stability, like a tail fin. It clamps to the gutters, holds 125 pounds directly over the rear wheels. Nicholson Mfg. Co., 318 G St., Davis, Calif., sells the carrier for \$29.95. It's also available through Volkswagen dealers.

Sleek and streamlined, this sealed aluminum carrier is designed to keep camping supplies dry in the heaviest downpour. The side hatch locks with a key. The racks can be used separately without the carrier for a boat, lumber, other loads. A 5' model sells for about \$110, a 6' model for \$120. They're made by Space Van, Inc., Box 104, Marshalltown, Iowa.

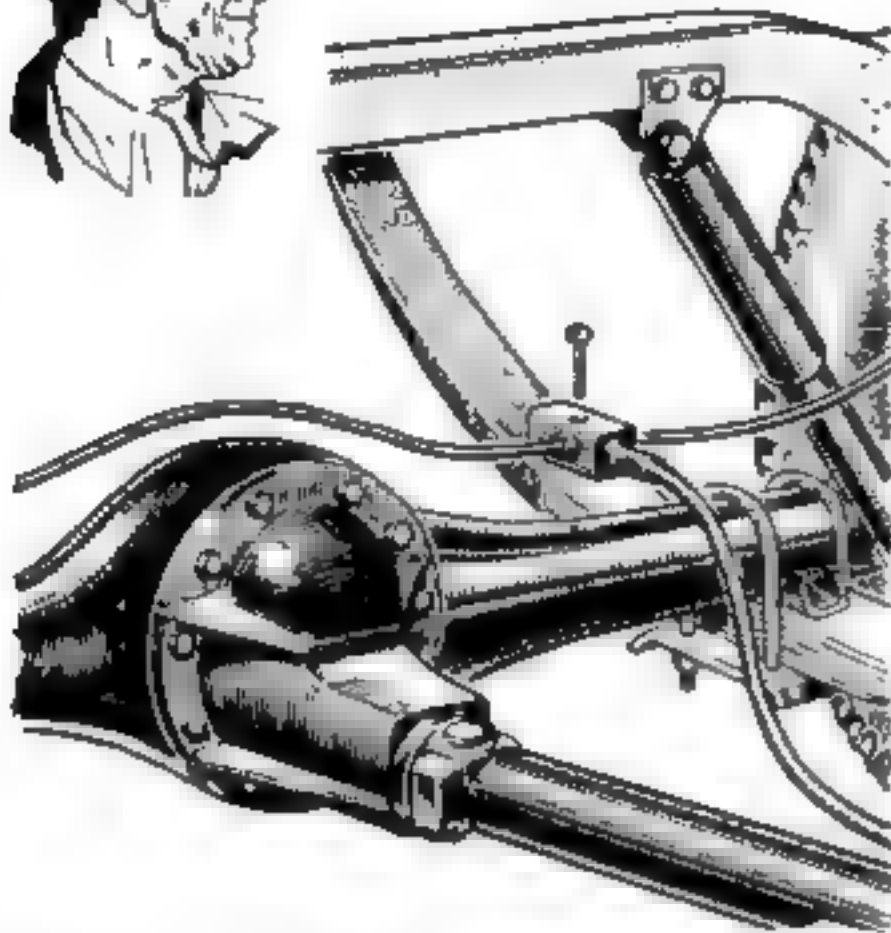
All the luggage that would normally fit in your trunk packs neatly into this weatherproof vinyl canopy. The flexible covering retains its shape when empty so you can load it easily, yet it can be folded flat when not in use. The zippered side flap can be locked with a padlock. The carrier comes in four lengths from 3' to 6', giving 12 to 24 cubic feet of stowage space. Prices run from about \$38 to \$60 from Karpak Co., Roanoke Bldg., Minneapolis.

This snap-in bag fits inside a standard roof rack and converts it to a fully enclosed weather-tight carrier. When the rack is wanted for other hauling, the bag can be unsnapped and lifted off. One shown here is made to fit Chevy racks and is available through Chevy dealers. Similar bags are made for many other makes of cars.





Hints from the Model Garage

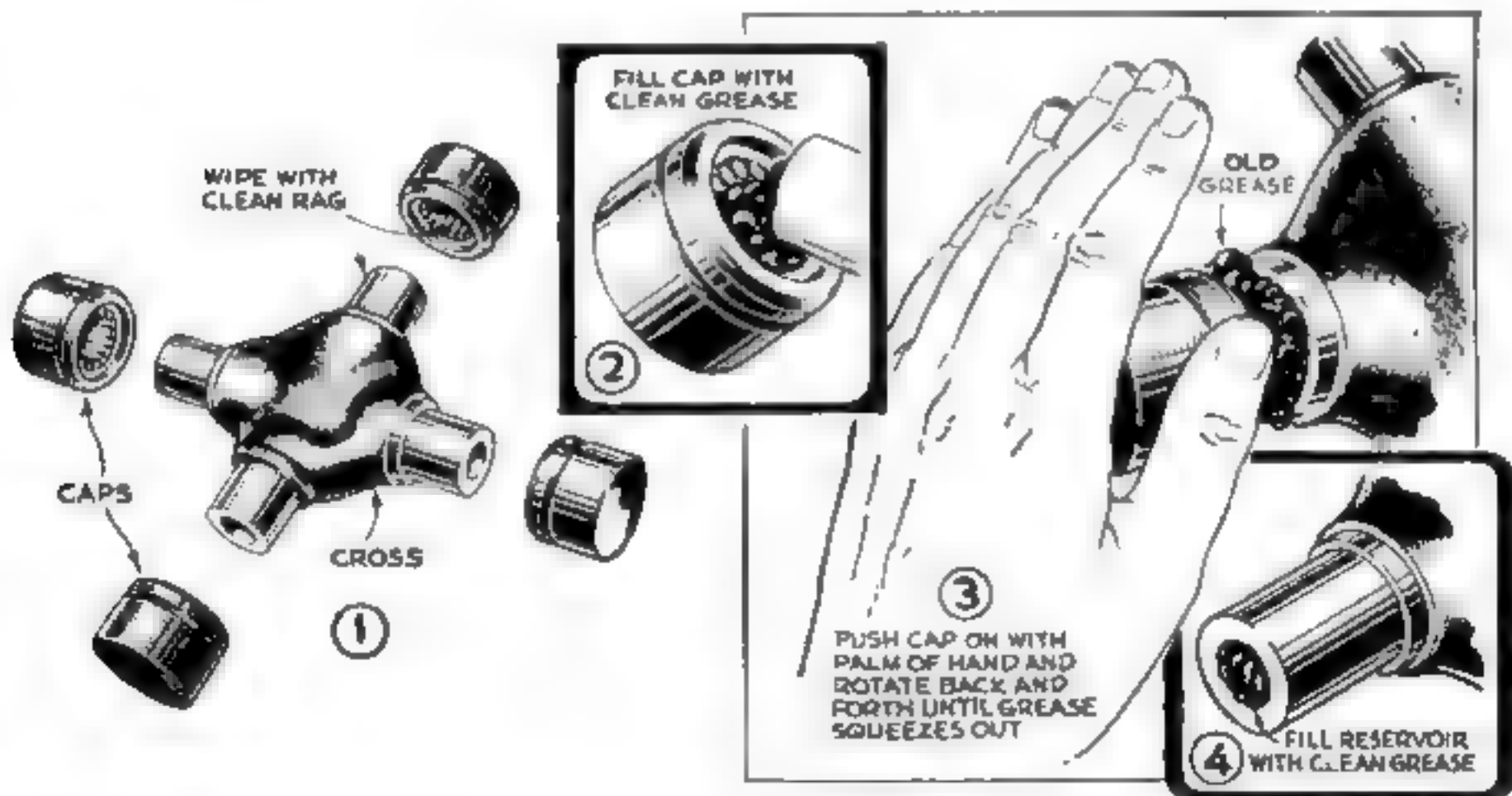


No need to bleed brakes after removing rear backing plates. Loosen the brake-line function box (bolted to rear axle); there's enough give in the flex lines to allow removal of backing plates without disconnecting the copper tubing.



Silence loose, squeaky windshields and rear windows with a little ordinary talcum powder. Run a nail file around the rubber gasket that holds the glass in place. As you pry the rubber away, sprinkle the powder between the gasket and the glass.

.....



Packing a universal joint is easy if you follow this procedure: When the joint is disassembled, wipe out as much of the dirty grease in the cap and cross as you can reach with a clean rag. Then fill the cup with clean grease and force it back on

the cross shaft, twisting it back and forth with the palm of your hand. The dirty grease will be forced out and can be wiped away. Repeat until the grease comes out clean. Now you can fill the reservoir and reassemble the universal joint.

FASTEST "DRAGSTERS" OF THEM ALL!

Designed for all-out acceleration over a quarter-mile straightaway, these two "dragsters" are the kings of their kind. And both spark their amazing power with silvery-plated Champion spark plugs . . .



ON LAND: By the yardstick commonly used in automotive road tests, going from a standing start to 60 mph in 10 seconds is potent performance indeed. This "dragster" took just 7.77 seconds to cover a quarter mile from a standing start, crossing the finish line at 190.26 mph! That's the quickest quarter-mile acceleration run on record, made last January by this remarkable racer. Built by Californians Keith Black and Tom Greer (driven by Don Prudhomme), its Chrysler engine is fired by Champion spark plugs.



ON SEA: Floating "dragsters" are fairly new on the speed scene—and they really travel. At the end of a quarter mile this boat, the "Golden Thing," was slashing over the water at a record speed of 152.80 mph! It happened at the World Championship Boat Drags last fall, with Chuck Gireth driving. The "Golden Thing's" Champion-equipped Chrysler engine was set up by the same Keith Black who co-owns and tunes the world's quickest land dragster (see above).

Why do engine experts like Keith Black—the man who prepared these two record-holding dragsters—choose Champion spark plugs? Because engine experts everywhere know from experience they can depend on Champions to deliver absolutely all the performance that can be squeezed out of an engine! Why settle for less from your engine? Always specify Champions.

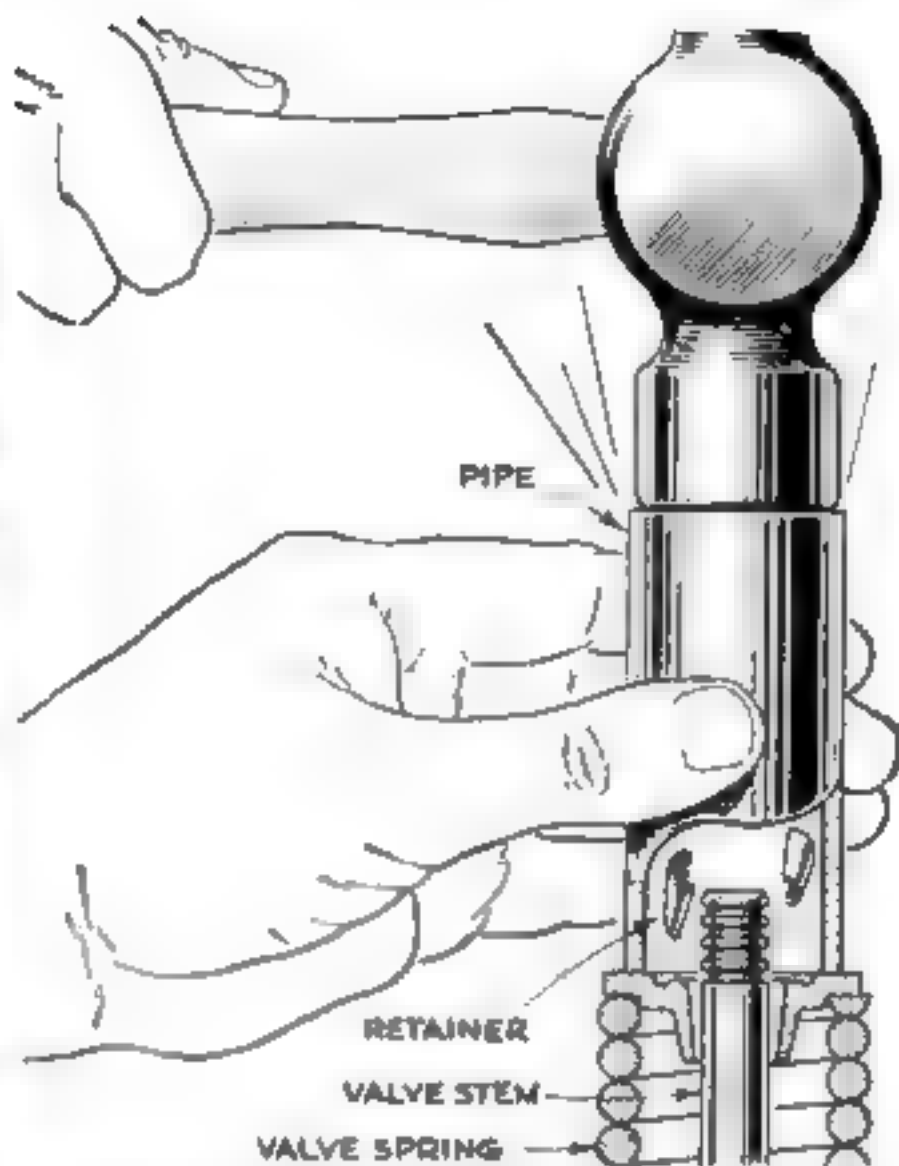


Champion Spark Plug Company
Toledo 1, Ohio

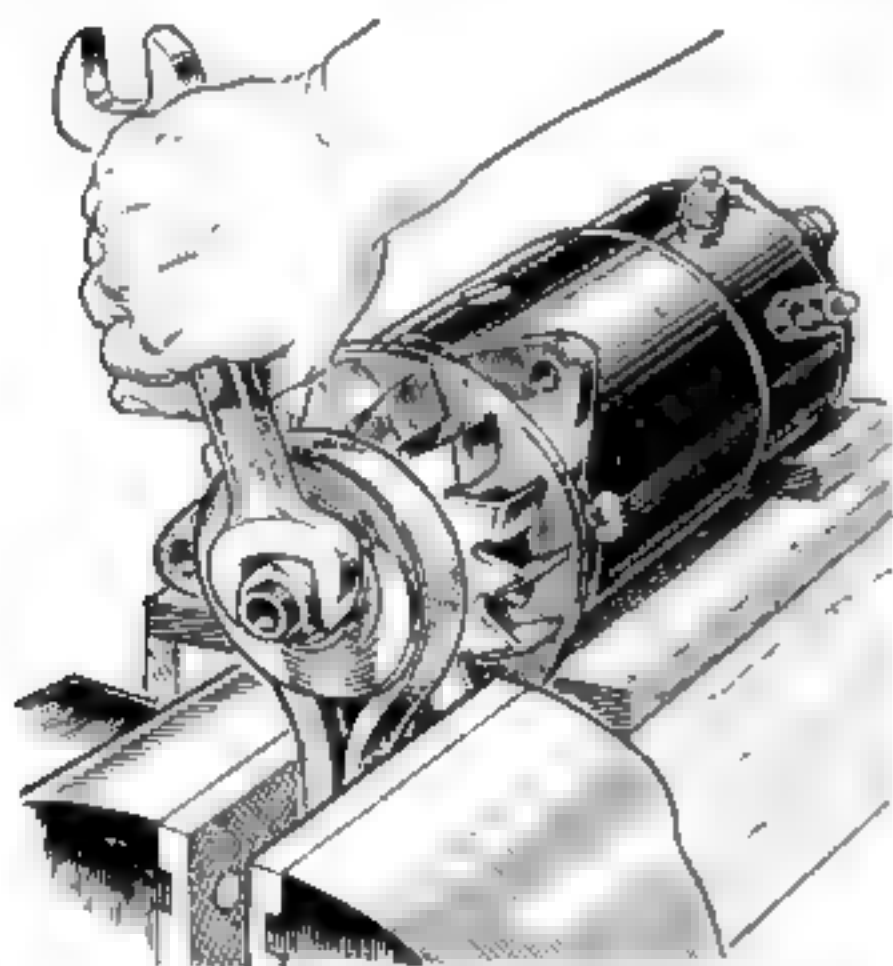
More Hints from the Model Garage



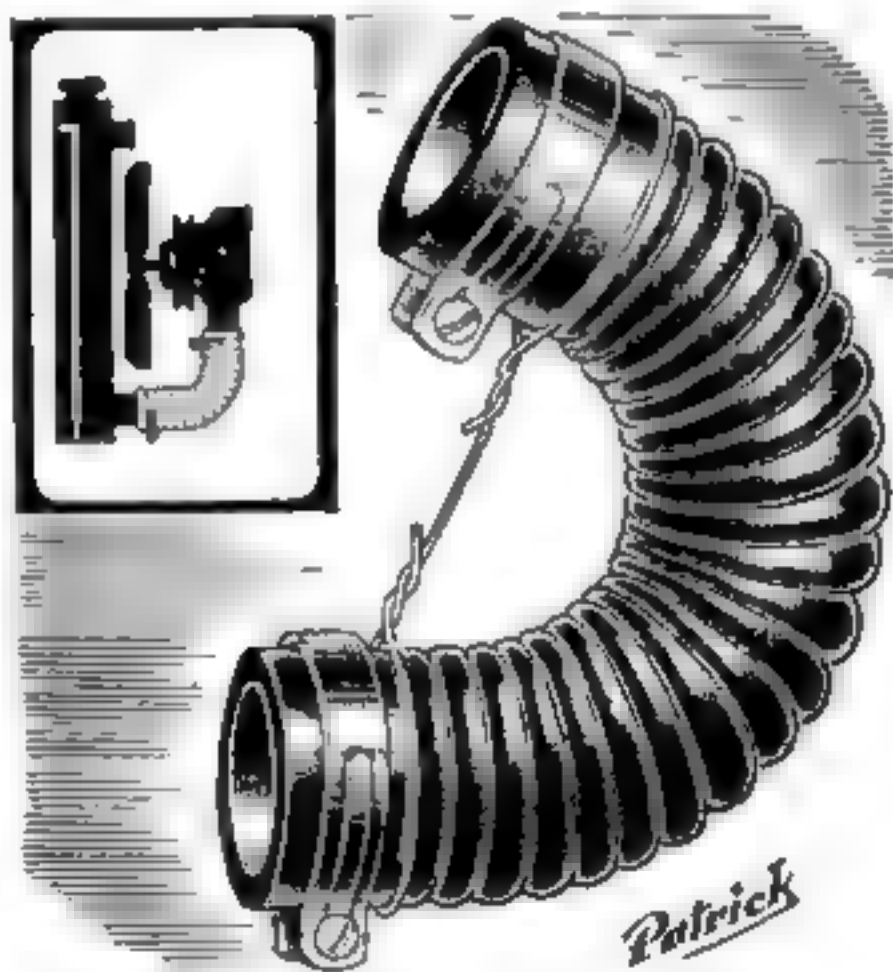
Check valve-spring tension with a bathroom scale. Cut cardboard tube to length specified for compressed spring. Lay cardboard strip over tube, and block of wood over spring. Step on wood. When the strip starts to tip, take a reading on the scale.



Overhead-valve retainers pop off with a minimum of fuss if you force them out with a piece of pipe. Slip the pipe over the valve stem onto the retainer washer. Strike the pipe a solid blow with a hammer. The retainers will jump out inside the pipe.



To loosen the nut on a generator, wrap an old fan belt around the pulley as tightly as possible. Then squeeze the belt in a vise. This will hold the generator securely and allow you to remove the nut without danger of damaging fragile parts.



Installing a flexible lower radiator hose isn't easy when working room is limited. Try preshaping the hose into a U and fastening the ends with wire. Position hose and loosen the wire. This releases the hose, which forces itself into place.

YOU BET YOUR LIFE ON YOUR SHOCK ABSORBERS



GUARD YOUR LIFE with Monroe-Matic® shock absorbers. On many occasions, law enforcement officers have reported worn shocks to be a frequent cause of accidents. Monroe-Matics prevent dangerous wheel bounce side sway, give extra stability and complete control for safer, more comfortable driving.



CHECK YOUR MILEAGE. After 25,000 miles, your shock absorbers are certainly due for replacement. Shocks wear so gradually that you're not aware of an increasingly rougher ride and loss of control. Don't take chances. Replace shocks all worn with new Monroe-Matics.



TAKE A TIP from the champions. Racing drivers choose Monroe-Matics almost exclusively for the ultimate in car control under the toughest conditions. Every Indianapolis winner in the past 11 years has ridden on Monroe-Matics. Safe highway driving also calls for Monroe-Matic control.

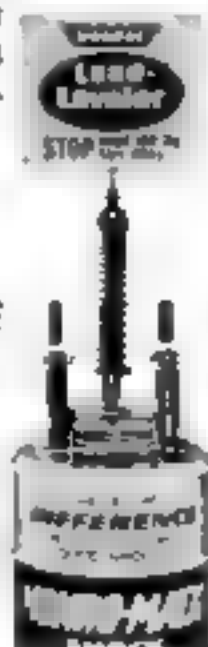
LOOK FOR THE YELLOW AND BLUE

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The girl turned to Gus. "Do you have any idea what he's talking about?"

Gus and the Case of

By Martin Bunn

IT WAS Saturday, and business was slow at the Model Garage. Stan Hicks had finished a job due at noon and was on his way to wash up for lunch when a car drove in.

"I'll take care of that," said Gus, coming from the office. "You go along to the diner."

"Thanks, Gus. I . . ." Stan swallowed his words as the driver got out—a petite brunette, no more than 19, and pretty enough to have stepped off a magazine cover. She wore a white satin blouse and a brightly colored skirt and cape.

"I've got time," Stan hastily assured Gus. "I'll see what I can do."

Gus looked toward the girl, grinned, and went back to the office.

The little brunette was scowling as Stan came up, her jaw set angrily, her eyes giving off sparks.

"Well, don't just stand there; go ahead and start," she demanded.

"Start? Start what, Miss?" asked Stan. She banged a small fist against the side of the car, a popular six-cylinder model about seven years old. "Just listen to it!"

Stan tore his attention from the pretty face. The car engine was idling irregularly, sometimes almost stalling.

"It sounded like Jack Benny's old Maxwell all the way from home," the girl cried. "Hurry up! I don't want to miss the whole meet!"

Stan opened the hood. "Has it been running like this for long?"



the Mysterious Miss

"Days and days. I've already had brand-new plugs put in the thing, so don't tell me it needs *them*."

The wiring was old but not visibly cracked. All six plugs evidently were new, although their porcelain was almost hidden by long, hardened rain caps. Stan gunned the engine briefly. It responded raggedly but there was none of the sputtering typical of fuel failure.

Letting it idle again, he wrapped a rag around his fingers and gently tugged on the cable to the number-six plug. It was tight on the plug terminal. So were the cables to plugs five and four. But the engine's off-beat rhythm changed as he pulled on the cable of number three. He yanked it off, and the engine stalled. Squeezing the cable socket a trifle, he pushed it back

on and restarted the engine. The miss was still there. The other two cables seemed tight.

"Look here, Miss—" began Stan.

"Ann Bliss. You look. Can't you fix it while I go to the track meet? I've come all the way from Stanville, and it's already half over. I tried three gas stations—and they couldn't fix it. One suggested I come here."

A horn blared outside.

"That's Betty!" shrieked the girl. "She's come to take me back; I've got to rush. *Please* see what you can do."

She was gone in a swirl of skirt.

"In a hurry, wasn't she?" commented Gus.

"Gong to that junior-college track meet at the stadium," answered Stan, dreamily. "Cute name she's got Bliss."

"Uh-huh. And you have about one hour to find that miss for Miss Bliss."

Methodically, Stan removed the plugs, reset the gaps on two, wiped the porcelains, and replaced all six plugs. He checked the point setting, made sure the high-tension cables were well spaced—neither cross-firing nor shorting to engine parts—and the low-tension wiring tight.

The engine still ran raggedly.

Nursing his hunch that ignition rather than the fuel system was at fault, Stan opened the distributor again. He pulled the center cable from the cap, held it near the engine, and, with the ignition on, flicked the points open by hand.

A juicy spark gave coil and condenser a clean bill of health.

Making sure that the cable end and its socket were clean, Stan examined the cap for corrosion, cracks, or spark tracks. He found none. The rotor seemed all right, but he put in a new one before trying the engine again.

It sounded just the same. Stan, head cocked, was puzzling out his next step when Gus came out.

"Just had a phone call from Mrs. Brownell. She's at the stadium and she says one power window is jammed and she can't move her car."

"Can't drive because a window's jammed? Sounds goofy."

"I know, but she's a sensible woman, and a good customer. I have to wait for Judge Toler to come for his car. You go—she's in parking lot B—and I'll take a look at this job."

Stan nodded, hastily explained what he'd done so far, and drove out.

Traffic was heavy as homeward-bound cars spread out from the stadium. But section B wasn't empty when Stan arrived. It held a milling, cheerfully noisy group of students—and Mrs. Brownell's big two-door sedan.

A serpentine line of students was chumba-

stepping around it. They cheered as Stan, toolbox in hand, broke through to the car.

From an almost-closed rear window hung a girl's arm.

Mrs. Brownell was standing beside the car. "Please do something, Stan," she said breathlessly. "You can see why I didn't dare drive—with her arm hanging out the window."

"I'll sure try," promised Stan.

"Some boys were teasing her," the woman explained. "So I thought I'd close the window with the button up front, not knowing they'd grabbed her hand and were holding it."

Stan opened the driver's door—and stared.

The trapped girl was Miss Bliss.

"Hey—never expected to see you here. But don't worry; the boss is fixing your car."

"Stop talking nonsense and get me out of this," the young woman retorted.

Turning the key to "radio," Stan tried the control button at the front window. It slid down obediently. Pressing the remote button for the rear window had no effect. The one at the window itself produced only a ratcheting

sound much like sprocket teeth jumping out of mesh.

Stan disconnected the battery. Getting into the rear of the car, he took the screws out of the window frame.

The girl shifted lithely out of the way as far as possible, while outside the crowd yelled encouragement, much of it suggesting a more personal approach.

Perspiring, Stan got the frame free of the window and hung it on the girl's shoulder.

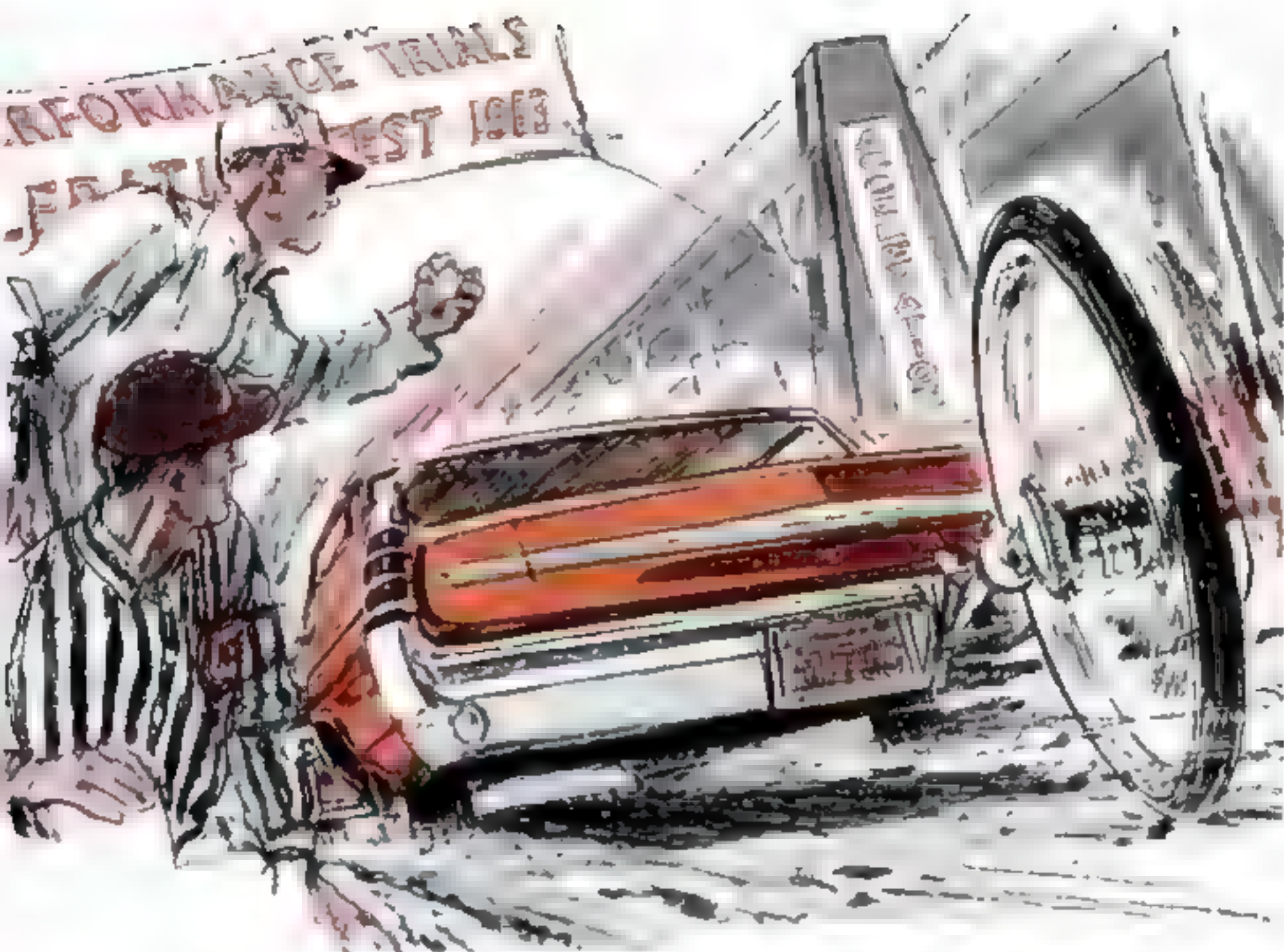
To detach the armrest he had to put one arm around the girl. Then, with the lining panel off, he loosened the screws holding the inspection plate.

Now he could see that the driven sprocket, overloaded when the girl's arm blocked the rising window, had sprung out of mesh. On-the-spot repairs were im-

What's this a photo of?



ANSWER: Not a shimmering zebra, but strip farming out west, following contours on each side of a draw.




AC SPARK PLUG  THE ELECTRONICS DIVISION OF GENERAL MOTORS

AC sparks five out of six

One of the real tests of any spark plug is acceleration—response when you want it most! In the 1963 Pure Oil Performance Trials at Daytona, stock cars equipped with standard AC Fire-Ring Spark Plugs captured first place in five out of six acceleration tests. One reason was AC's Self-Cleaning Hot Tip. It heats faster to burn away harmful carbon deposits. The result: sustained peak power mile after mile.

Get the same winning power response from your car. Be sure your tune-ups include performance-proved AC Fire-Ring Spark Plugs with the Self-Cleaning Hot Tip.

 Acceleration competition was in the important driving range starting at 25 miles per hour. All entries were finely tuned, used premium gasoline, and were driven by professional drivers. These tests are not a measure of vehicle top speeds.



**FIRE-RING
SPARK PLUGS**

possible. The only course was to remove a bolt that served as the pivot of the lifting arm.

Stan considered, with some agitation, the task before him. The nut was hard to reach, to hold the bolt, too, he'd have to use two wrenches, working close to the window. He began to wish the crowd outside would all go home.

He explained to the girl. She gave him a blistering glance and shrank back, arching her body to let him reach past. Stan became acutely aware of her perfume, while quips from the crowd grew louder. The wrenches felt grease covered. Once Stan almost dropped one inside the window space. The nut could be turned only a little at a time.

Finally it came off, to his relief. He tapped out the bolt and caught the window-pane just as it dropped.

A cheer rang out as the girl drew in her arm and squirmed away, across the wide seat. Mrs. Brownell was by her side at once with a first-aid kit. Stan scrambled out of the sedan.

"Drive to the garage and we'll fix the window, ma'am," he said, turning toward the pickup.

Suddenly the ground fell away under him as hands clutched and raised him. To a chorus of "He's a Jolly Good Fellow" he was carried to the truck.

Gus was writing out a bill for Judge Toler when Stan drove in and made for Gus. "How'd you make out?" he asked.

"Didn't get far with your job," confessed Gus. "The judge had a million questions, as usual."

"Got an idea," said Stan. He started the engine, then switched off the droplight he had been using.

For a moment they could see little. Then Stan spotted a faint bluish thread snapping along number-one plug.

"You got it, Stan," agreed Gus. "Intermittent shorting—there it is at numbers two and three, too."

Sparks were jumping between the rain caps and the screw shells of the plugs. Stan tugged at number-three cable. The sparking ceased, and the engine seemed to steady slightly. He pushed the cable on hard, and immediately the sparks appeared again.

"Haven't you finished yet?" The last word was a squeak of dismay.

Both men turned to confront the owner of the car—and the white satin blouse.

"Been kind of busy with a few other things," returned Stan. "Like getting you loose at the stadium."

The girl turned to Gus. "Do you have any idea what he's talking about?"

"No, but let me ask one," said Gus. "Has this car had a radiator leak?"

"Uh-huh. Water sprayed all over before it was fixed. Why?"

Gus had pulled off a plug cable. He folded back the edge of its rain cap.

"Look at this, Miss," he said. "Here's why—and Stan found it. These old hoods are loose on the plugs, so some spray bounced off the engine and got into them. Old radiator water's rusty. It dried inside these caps, but the rust stayed. That made a dandy path for short-circuiting ignition juice."

"How long will I be held up here?" asked the girl, sounding worried.

"I'll put on all new caps," said Stan. "Quickest way to finish this job."

The girl watched coolly as he set to work. Just as he finished, the Brownell car drove in.

"I didn't come about the window," the driver called. "Just to bring Katy. She's so grateful to Stan. So am I."

Stan swiveled his head in bewilderment from the girl beside him to the one getting out of the car. Their dress was identical—swirly skirts and white satin blouses.

"Hey! There are two!"

"There always are—of twins," said Mrs. Brownell. "I'll be back with the car on Monday."

She drove out. Stan started the engine. It idled perfectly.

"That does it, gals. No more missing, now."

Stan closed the hood and turned to find himself facing Ann Bliss. He grinned tentatively.

"Guess I acted like a creep," she said, smiling. "I'm sure grateful to you for fixing the car, and I get the idea that you did something nice for my sister, too. So thanks awfully."

Stan's grin widened.

"Did you know," asked Ann Bliss, "that three other mechanics flunked out on this job? It took *you* to solve the case of the mystery miss."

"Two misses," returned Stan. "The car part was only half of it." ■ ■

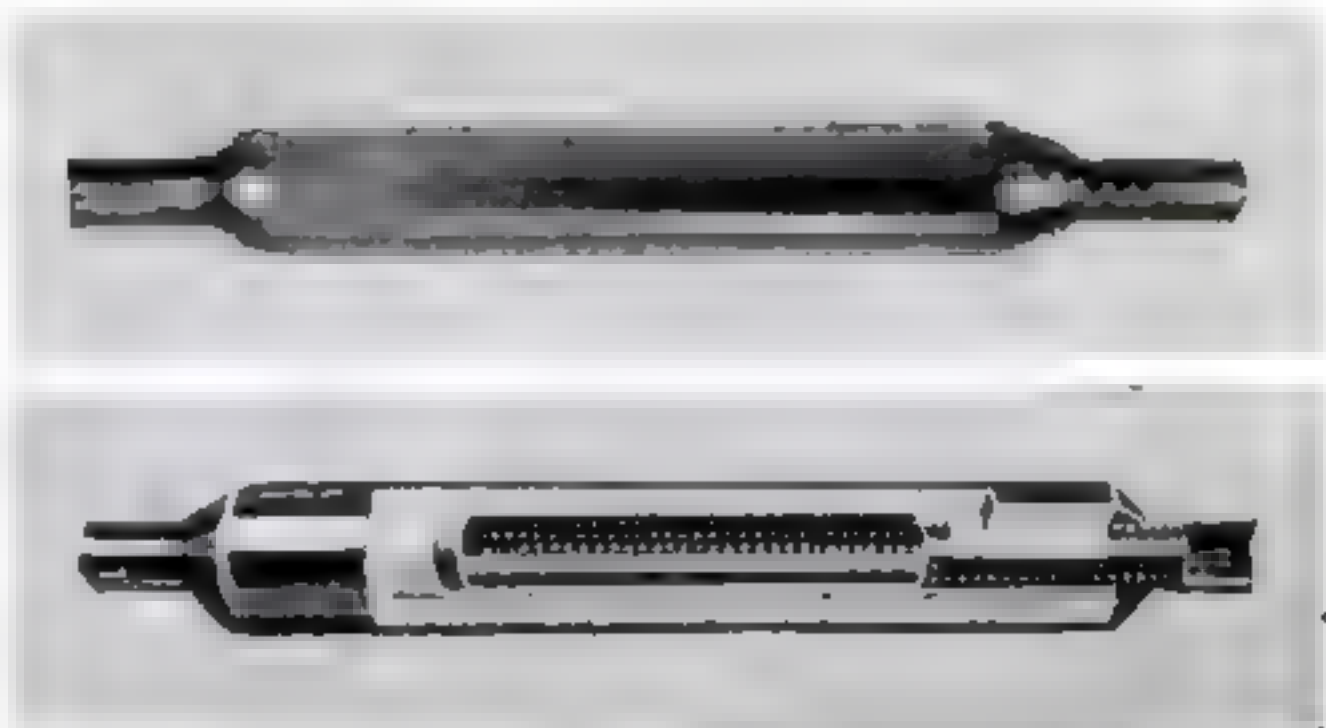
Here's what we mean when we say the **continental mark II** really is a new...and different muffler!

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Smooth, streamlined one-piece European-type muffler...with no seams to open up...no joints to blow...no connections to crack or break loose. Heavy-gauge steel, coated for extra durability and rust resistance.

NEW INSIDE

Straight-through design eliminates restrictions to free flow of exhaust gases. New sound-absorbing glass fibre insulation cuts engine noise to an authoritative purr of power!



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NEWLY ENGINEERED for top engine performance and gas economy. The Continental Mark II is made by Walker, one of the largest makers of mufflers for new cars. Walker engineers incorporated design features that prevent build-up of back pressure, and thus help engines deliver full smooth-flowing power for quick acceleration, hill climbing, real traffic flash, and maximum gas economy. You can buy a Walker Continental Mark II from your regular service station or garage.

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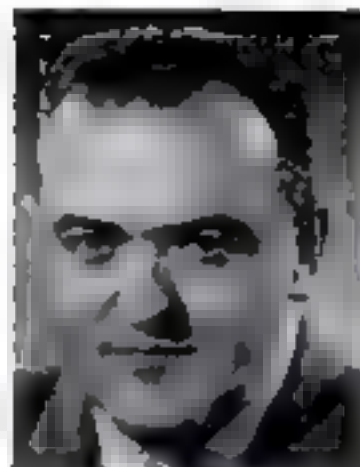
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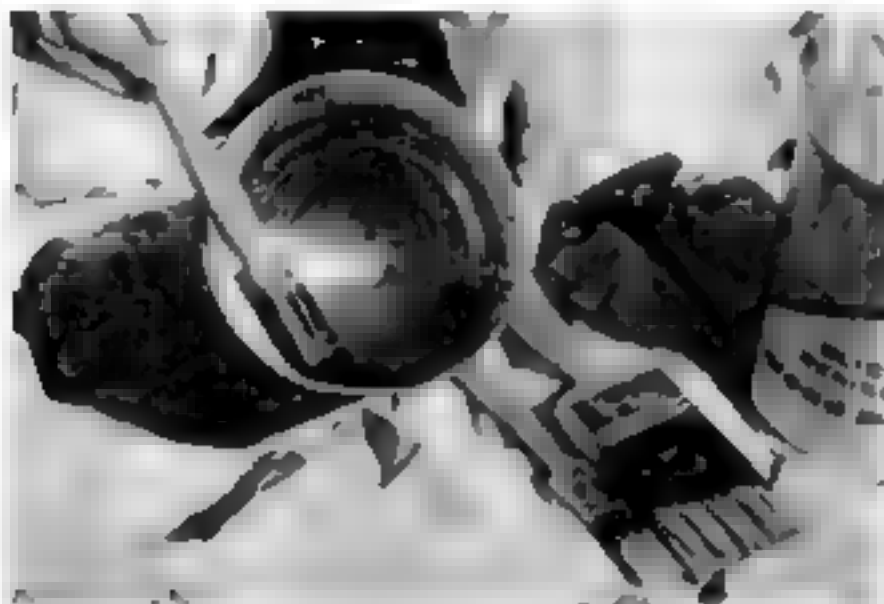
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SHOP TALK

By Sheldon M. Gallager



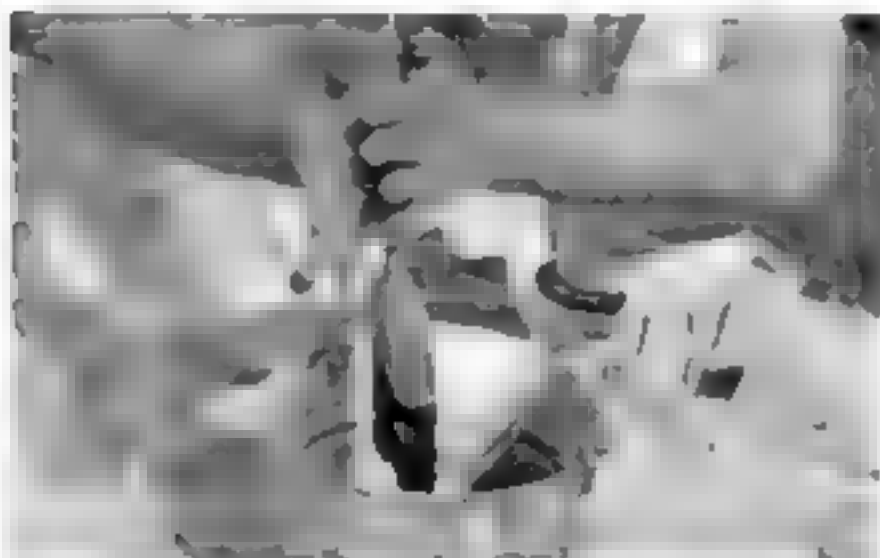
Hate to clean paintbrushes? Try this tip from the experts



Soak the brush well—in two separate solvents.



Next, rinse it in mild detergent and warm water.



Finally, spin it dry, wrap in paper, and store.

I figure the Du Pont people make a lot of paint and ought to know how to get it out of a brush, so I asked them. The secret, on oil-base paints, is a double soak. Fill two containers with solvent or whatever brush bath you usually use. Work the paint out of the brush in one container, then repeat the process in the other container. This gets rid of paint that would normally be deposited back on the brush from dirty cleaner in the first container.

Follow this with a bath in mild detergent, a warm-water rinse, and a final spin dry. On water-base paints, skip the solvent steps, but follow the same procedure with detergent and warm water. You'll be surprised, says Du Pont, at how you can keep a fine brush in good condition for years this way. Incidentally, here's an interesting fact: According to Du Pont, a nylon-bristle brush is a far better bet on water-base paints than natural bristles. The reason: Natural bristles soak up the water, swell out of shape, and quickly become difficult to use. Nylon bristles do not absorb water.

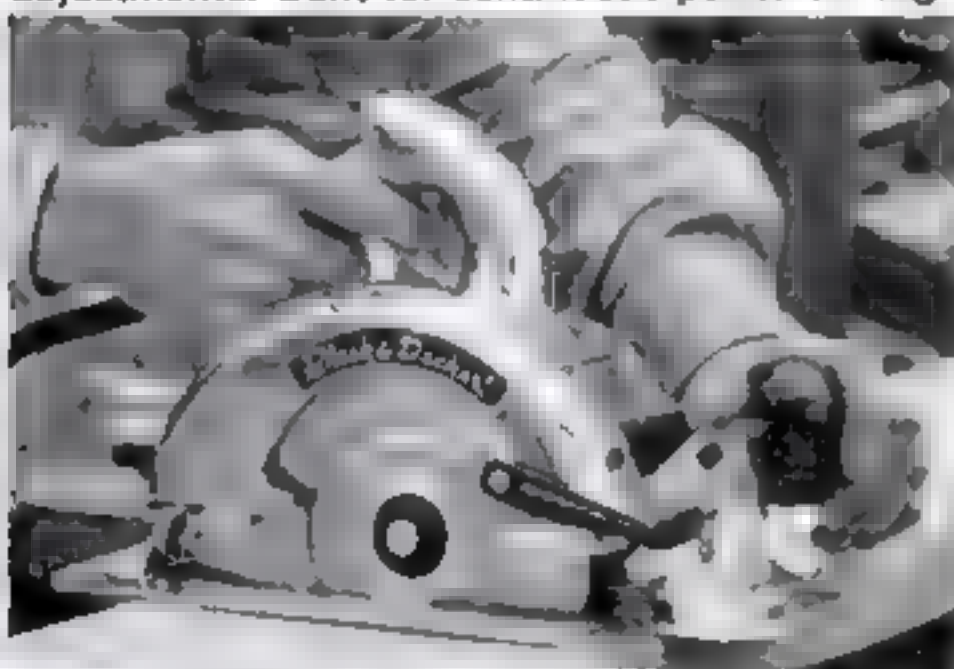
Now: Do-it-yourself lab equipment

If you enjoy doing science experiments with a youngster, I think you'll go for a fine new book that I've had as much fun with as my own son, Scott. Entitled *Build-It-Yourself Science Laboratory*, it's packed with 200 pieces of equipment you can make inexpensively for experiments in physics, chemistry, biology, geology, astronomy, navigation, meteorology, and other subjects. Published by Doubleday, NYC, it will sell for \$4.50. The author is Raymond E. Barrett.

New use for a fishing sinker: It'll make a drill bit stick

Ever have trouble chucking a tiny drill bit when the jaws won't close down far enough to grip it? Here's a tip from R. H. Hunger of Washington, Ill.: Press the bit into a split-type fishing sinker, then chuck the sinker. Adjust it on scrap first for minimum runout.

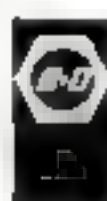
PROFESSIONAL'S PRIDE. Black & Decker's U-337 7¼" Professional Heavy-Duty Saw has superior M-L wire for increased overload burnout protection. All ball bearings. Accurate depth and bevel adjustments. Built for continuous power sawing.



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Pick the saws that are powered for top performance by the world's leading maker of power tool motors.



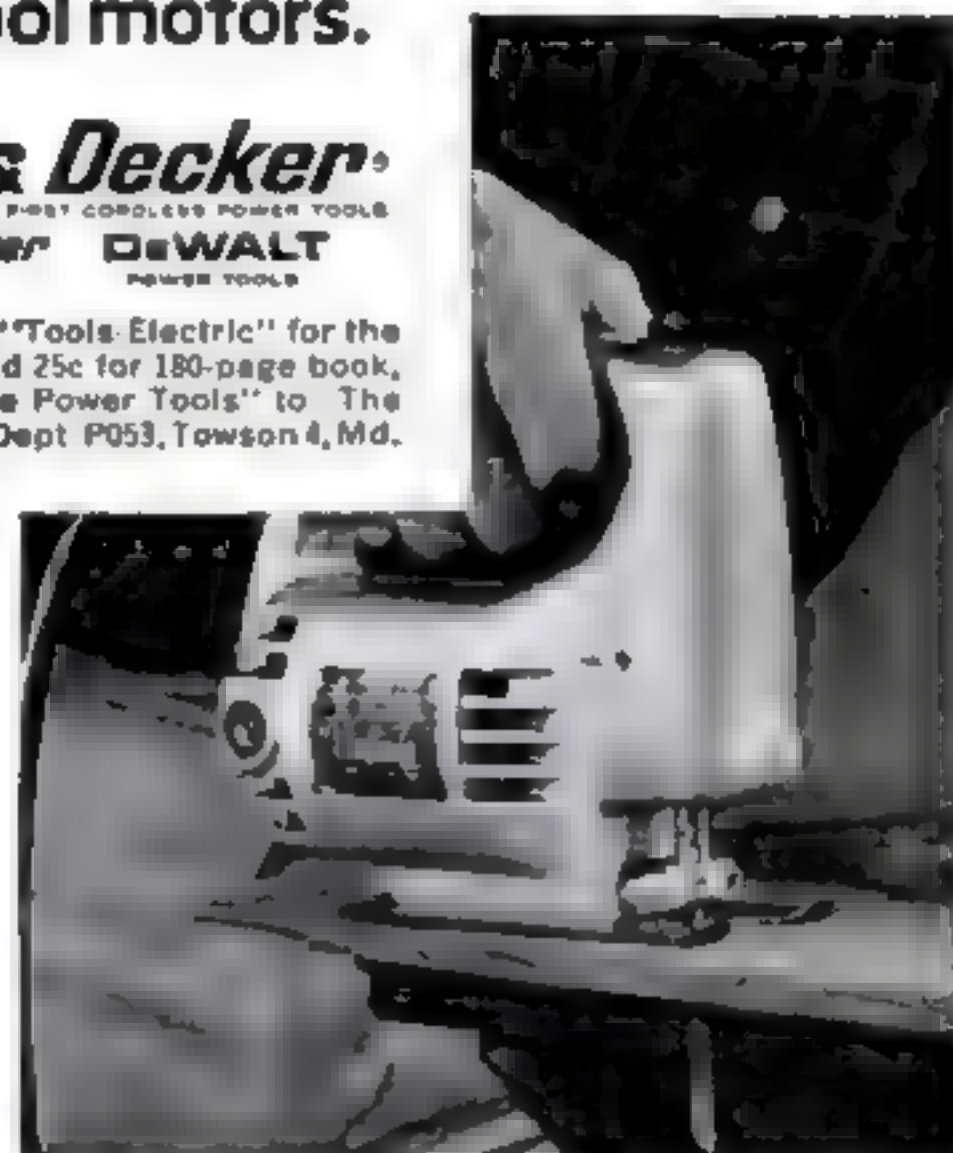
Black & Decker

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CHECK YELLOW PAGES "Tools Electric" for the nearest B&D dealer. Send 25c for 180-page book, "How to Choose and Use Power Tools" to The Black & Decker Mfg. Co., Dept. P053, Towson 4, Md.



CYCLOID ACTION. Black & Decker's U-351 Professional Jig Saw has fast, extra-smooth cutting power. Blade teeth cleared on each stroke. Nylon shoe insert. Tilting shoe for bevels up to 45°. Four blades, rip fence, circle-cutting guide included.



HIGH ON PERFORMANCE—LOW ON PRICE. Black & Decker's U-151 Utility Jig Saw handles like a sports car—makes straight, curved or irregular cuts effortlessly in wood, metal, plastic. Perfect balance and control. Jig saws from under \$24.

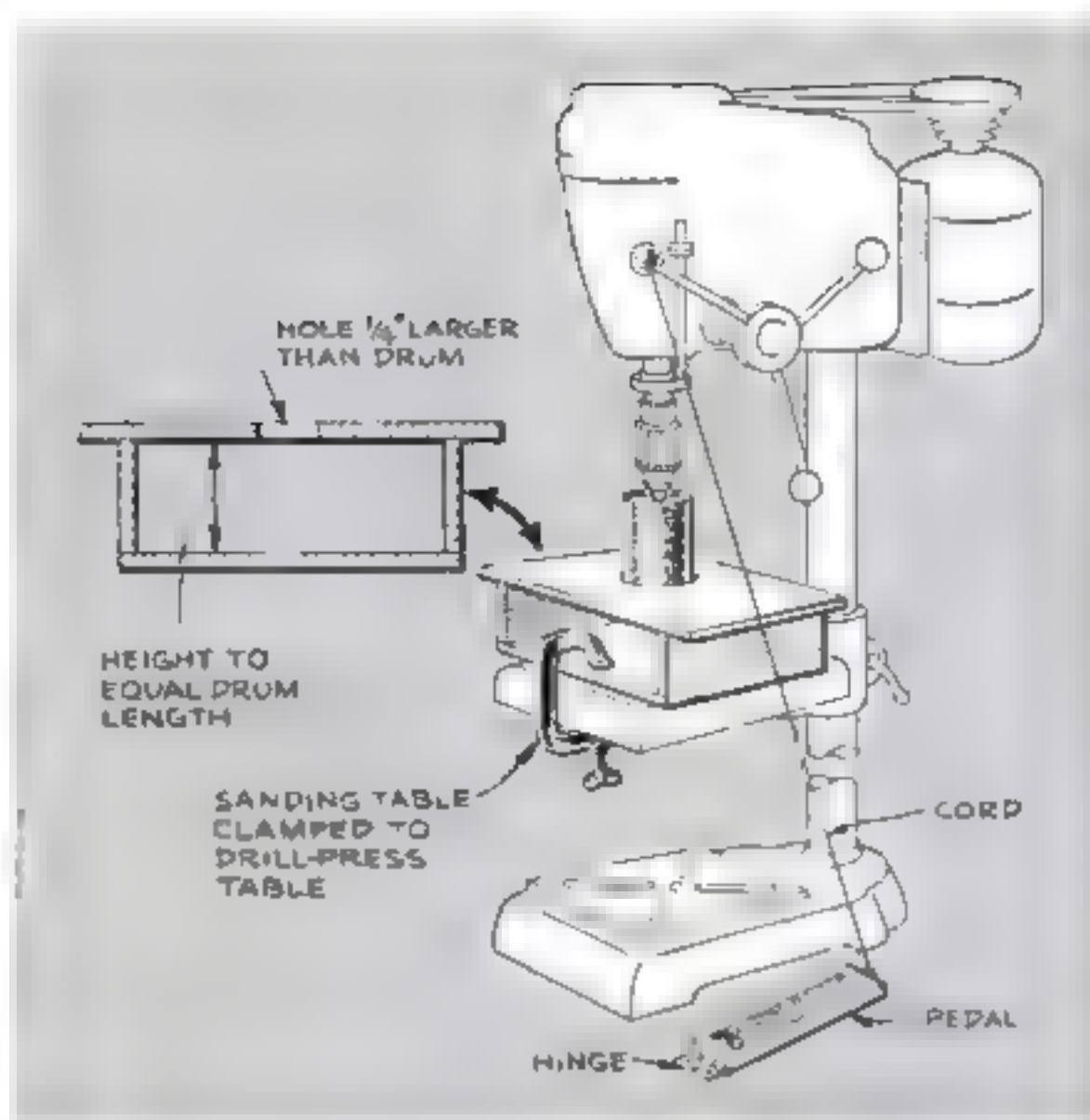
Short Cuts and Tips

FROM
PS
READERS

Pedal oscillates sanding drum on drill press

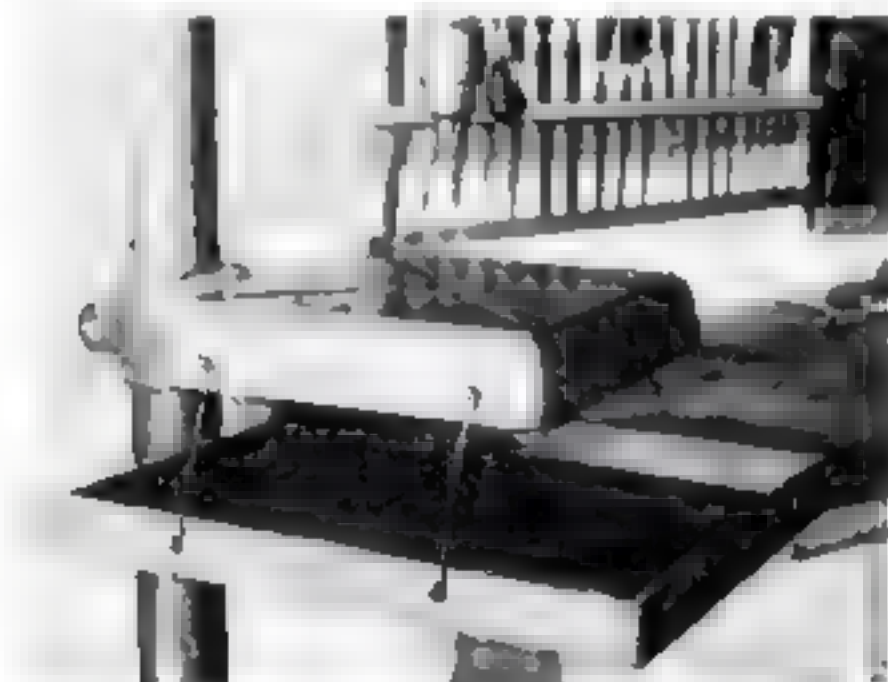
Sandpaper on a sanding drum used in a drill press will last much longer if you make the drum oscillate the way commercial spindles do.

You'll need a wooden table to mount on top of the regular one—with a hole in the top $\frac{1}{4}$ " larger than the sanding drum. Hinge a pedal to the floor and run a cord from the free end up to the feed handle, to free your hands for the work.—*King Basham Jr., Linden, Tex.*



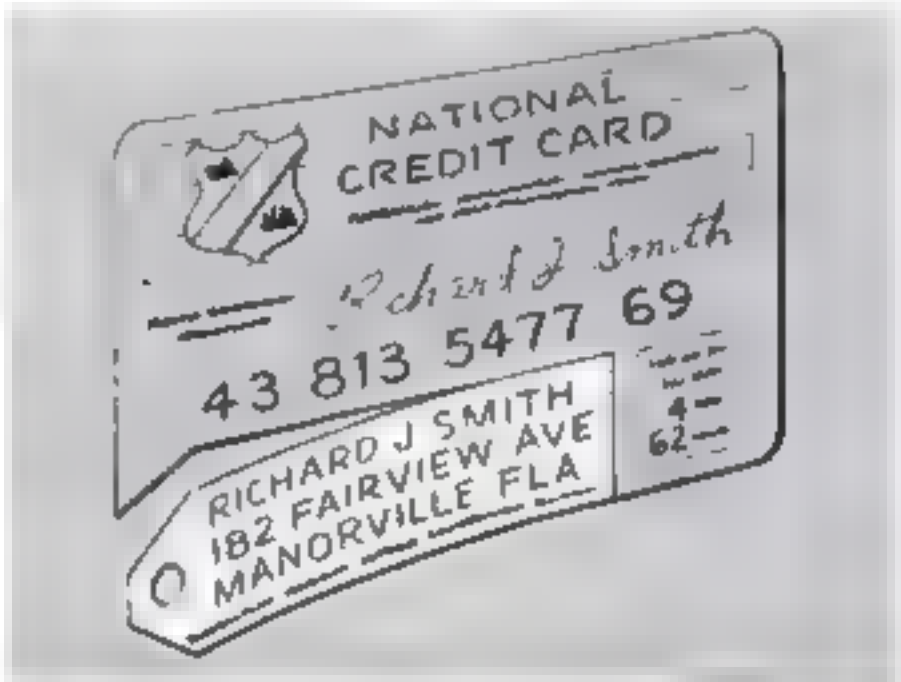
▶▶▶The cab of a truck is always short on storage space. I solved the problem by attaching a motorcycle saddle bag to the inside of each door with sheet-metal screws. By carrying my tools, rags, and extra parts in these bags, I keep such items clean, off the floor, out of sight—yet within easy reach.—*Dean I. Sille, Newton, Iowa.*

▶▶▶One workshop accessory gets my wife's endorsement: a door mat at the exit. I wipe my shoes when I leave, so I won't track sawdust, shavings, metal filings, or paint and oil drippings into the rest of the house. It saves me work, too—I don't have to refinish scratched and stained floors.—*A. R. Tanner, Poughkeepsie, N. Y.*



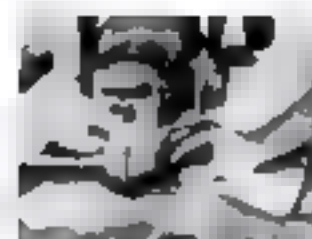
Chip catcher for a drill press

A tray slung 6" below the table of my drill press saves cleanup time. It is 4" wider than the drill-press table, and extends about 2" at the front. The bottom is $\frac{1}{2}$ " hardboard, and the sides are $\frac{1}{2}$ " by $1\frac{1}{2}$ " deep. For cleaning, it unhooks from the four 8-32 machine screws in the table edge.—*Dana S. Greenlaw, St. Petersburg, Fla.*



Name tags from credit cards

Don't discard old identification or credit cards. If you snip out the section with your name and address, and punch a hole in one end, you've got a readymade tag for luggage, camera cases, key chains, and other valuable articles. Cards that are printed on plastic make the most durable tags.—*Harold L. Gray, Crawfordsville, Ind.*



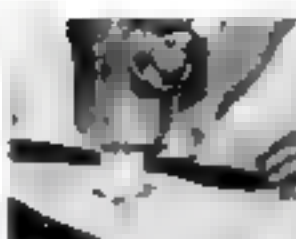
Seber Saw



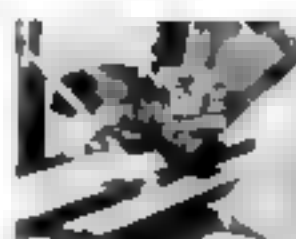
Radial Power Saw



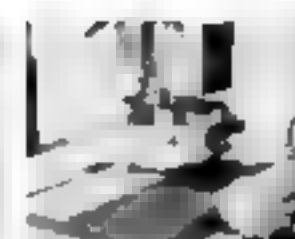
Jointer



Drum Sander



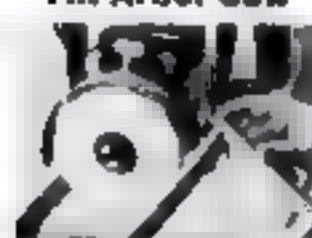
Shaper



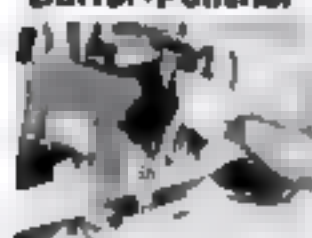
Surfacer



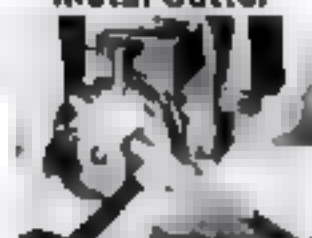
Tilt Arbor Saw



Buffer-Polisher



Metal Cutter



Grinder



Dado Saw



12" Lathe



Horizontal Drill



Router



Disc Sander



NEW DEWALT POWER SHOP* SAVES YOU HUNDREDS OF DOLLARS IN POWER TOOLS

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what's new

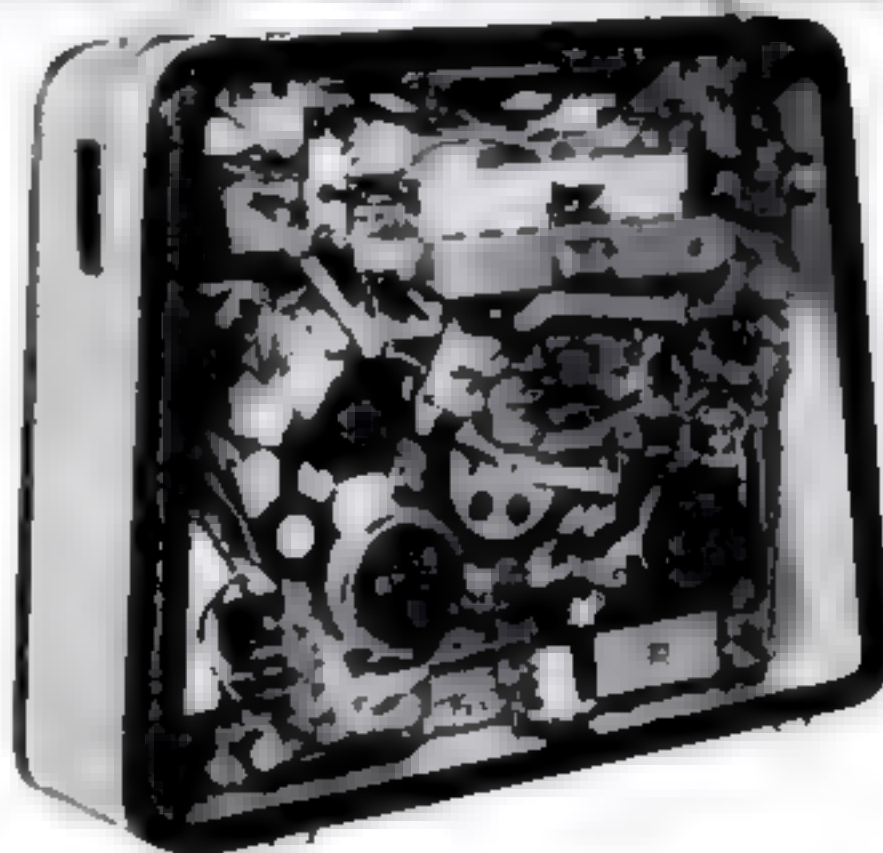
ELECTRONICS



Stereo Recorder Is Transistorized

THIS full-size, four-track stereo tape recorder has transistor amplifiers and a fourth speed ($\frac{1}{4}$ " per second) giving up to 32 hours of recording on a 7" reel.

I used one for several weeks and was particularly impressed by the sound at its slowest speed. At $\frac{1}{4}$ i.p.s., voices were natural and even music reproduction was creditable—better than on most AM radios. At the other end of the speed range, $7\frac{1}{2}$ i.p.s., you can make professional sounding live recordings in stereo with the stereo mike supplied. Prerecorded tapes played through your hi-fi stereo system compare favorably with the very best program sources. My only complaint, a rude me-

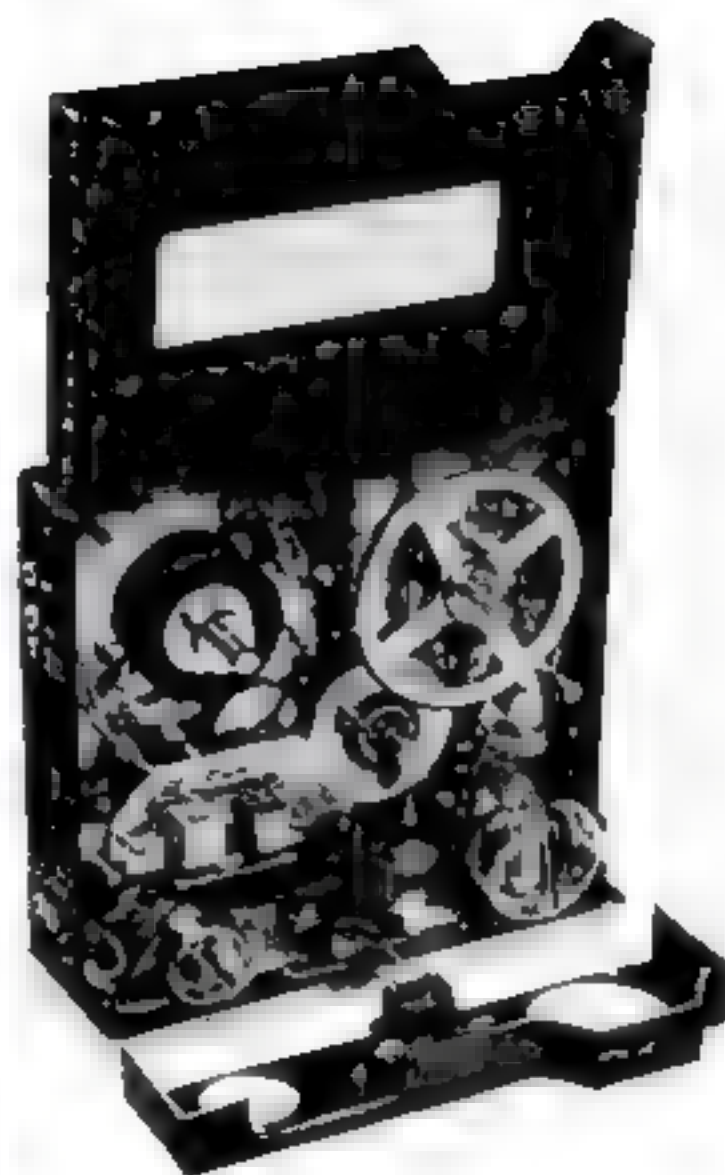


chanical noise when control is first engaged for higher speeds. But once started, there was no problem. The Norelco Continental 401 lists at \$399.50—*Hubert Luckett*.



Transistor portable gets FM, AM, and SW

You can listen to your favorite FM stations as well as short wave and standard AM stations on this 10-transistor portable. At home, you can plug it into your hi-fi system and use it as an FM tuner. It has automatic frequency control (AFC) to prevent drift on FM. Four standard C-size flashlight batteries supply power. Called the "Standard," model SR-J800F sells for \$89.95.



Portable recorder goes hi-fi

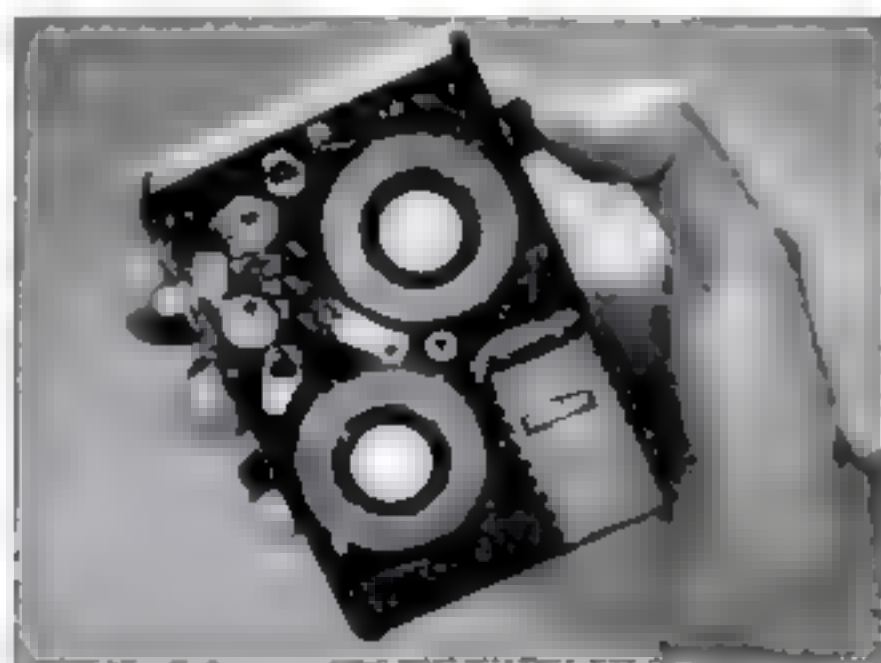
Here is a battery-powered tape recorder that offers the tape speeds and most of the features of a home tape recorder. It operates at either $3\frac{1}{2}$ or $7\frac{1}{2}$ i.p.s. with wow and flutter below .18 percent, says the manufacturer. It has AC bias and erase,

a precision capstan drive, recording-level meter, and provision for remote control. Six penlight cells provide power. A telephone recording pickup and earphone come with it. Size 7" by $7\frac{1}{2}$ " by $2\frac{1}{2}$ ". Weight: 6 pounds. Price of Citroen 660, \$159.50.



Light up and listen

This miniature radio-lighter combination, scarcely larger than an ordinary lighter, contains a two-transistor radio with built-in antenna and battery. The radio comes on when you plug in the earphone. Standard 40-cent mercury cell lasts about 200 hours. \$9.95 by mail order from L. Bravold, 5718 Troost Ave., North Hollywood, Calif.



A talking notebook

A tiny tape recorder, little bigger than a pack of cigarettes, records up to an hour on one re-usable, indexed, reel of tape. A built-in microphone in the Memocord lets you record interviews or notes without external wires. It uses one 9-volt battery and one $1\frac{1}{2}$ -volt penlight cell. Memo cord, P.O. Box 234, Troy, N. Y. Price: \$99.95.

CONTINUED



Tone arm (arrow), held in position by spring, plays record from underneath.



Twelve disks can be carried along in storage well at the back of the unit.

Rock and Roll While You Stroll

THIS new battery-powered radio-phonograph will play 45-r.p.m. records while being carried. It will even play when turned upside down. Both radio and record player operate on a single battery of four D-size flashlight cells.

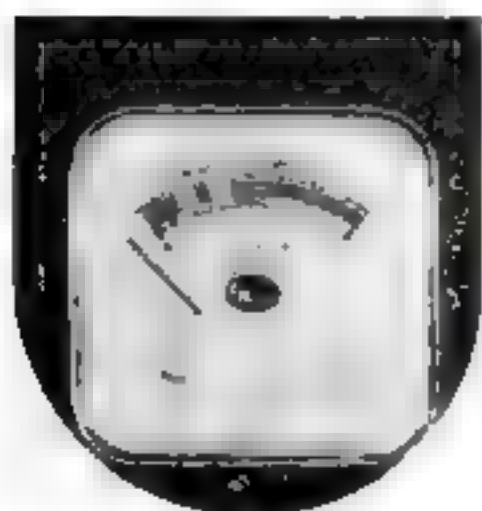
Records are held on a freely turning spindle with spring clips. A rubber wheel in contact with the record rim turns the disk. The motor is transistor-regulated to save battery energy. A plastic lid snaps in place in front to enclose and protect the machinery while it is operating.

Play is semi-automatic—you put the rec-



Radio dial, pushbutton controls, and speaker face up when unit is carried.

ord on the spindle and push a button. The tone arm comes down automatically and also returns to the starting position when the record is finished. The "Swing-Along" is marketed by Channel Master, Ellenville, N. Y. Price: \$79.95.



Battery-generator voltage indicator

This accessory meter comes with a complete kit and instructions for installing it on your car or boat. It is made in 6-, 12-, 24-, and 32-volt models for addition to any battery-powered electrical system. The Volticator is a suppressed-zero voltmeter with an expanded scale over the operating range. You can tell at a glance if your generator is working properly, whether your voltage regulator is properly adjusted, or if your battery is draining. The Leece-Neville voltmeter is available at local parts dealers for about \$13.

*Carl E. Weller,
the man who
took the wait
out of soldering.*



Have Gun —Will Solder

The instant-heat soldering gun is one of those rarities—a hand tool that was truly a new and needed invention

By Hubert Luckett

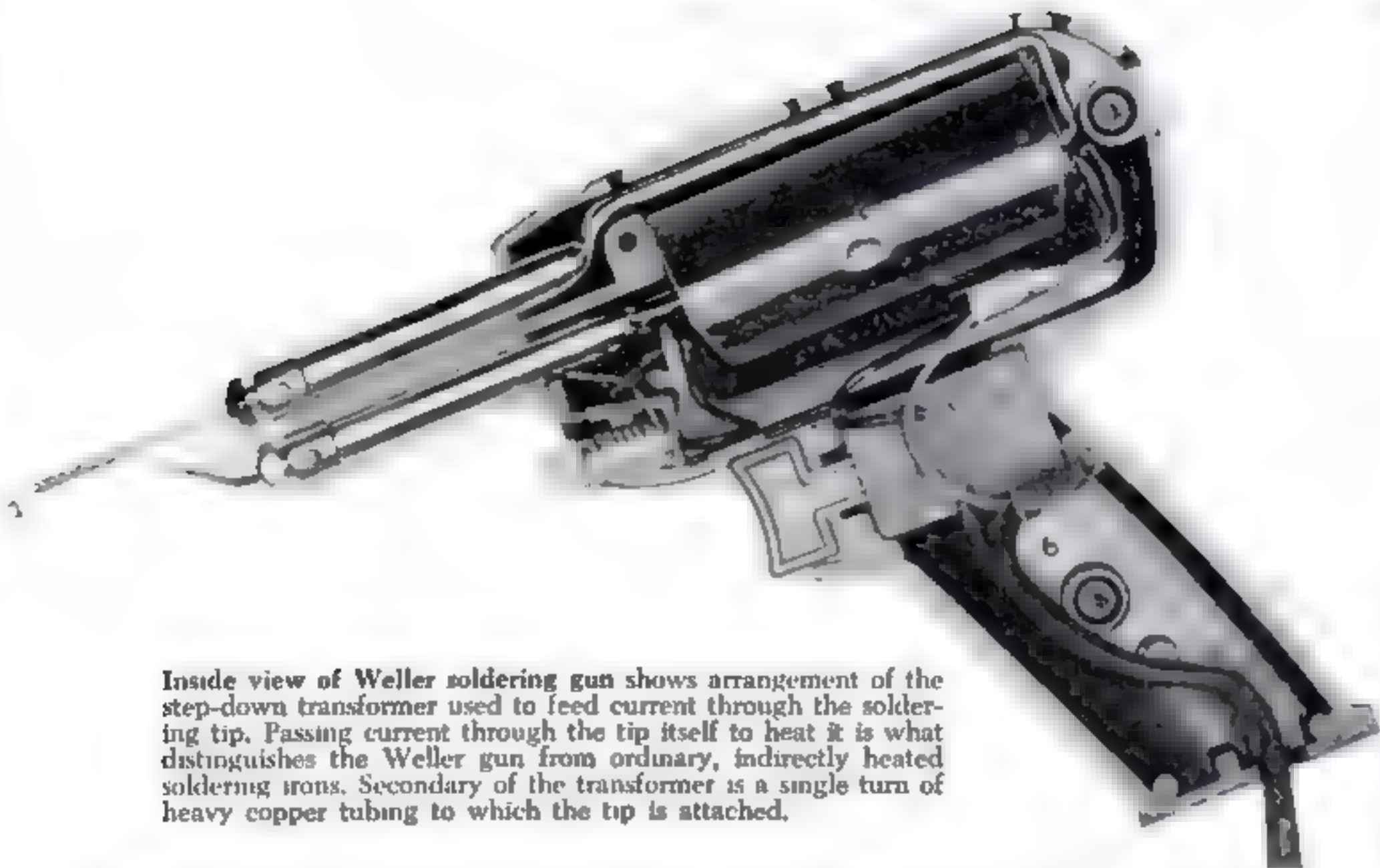
ANY good workman gets ideas on the job for tools that will make his work easier or faster. But few are able to parlay such an idea into a five-million-dollar business.

Carl Weller did it with his soldering gun

Back in the Thirties, Weller was a radio repairman. The soldering iron was to his trade what the handsaw was to the carpenter, the mill file to a machinist, the Stillson to a plumber. But it was a time waster. In the shop you kept it hot all day to avoid waiting when you needed to make a solder joint. This meant frequent redressing

CONTINUED





Inside view of Weller soldering gun shows arrangement of the step-down transformer used to feed current through the soldering tip. Passing current through the tip itself to heat it is what distinguishes the Weller gun from ordinary, indirectly heated soldering irons. Secondary of the transformer is a single turn of heavy copper tubing to which the tip is attached.

or replacement of the tip. On house calls, you twiddled your thumbs while you waited for it to heat; and when you finished the job, it was too hot to put in the toolbox.

Probably there wasn't a man in the business who didn't dream of an instant-heating soldering tool. There were plenty who, like Weller, tried to invent it.

The basic difficulty with the conventional iron—its indirectly heated working tip—was correctly analyzed by many. Current flowing through a coil of resistance wire had to heat the wire first; then the hot wires had to heat the copper tip by thermal conduction. A lot of heat got soaked up before the tip reached soldering temperature.

More than one would-be inventor asked the right question: Why not use the electric current to heat the tip directly? But Weller got to the Patent Office first with the right answer as to *how*.

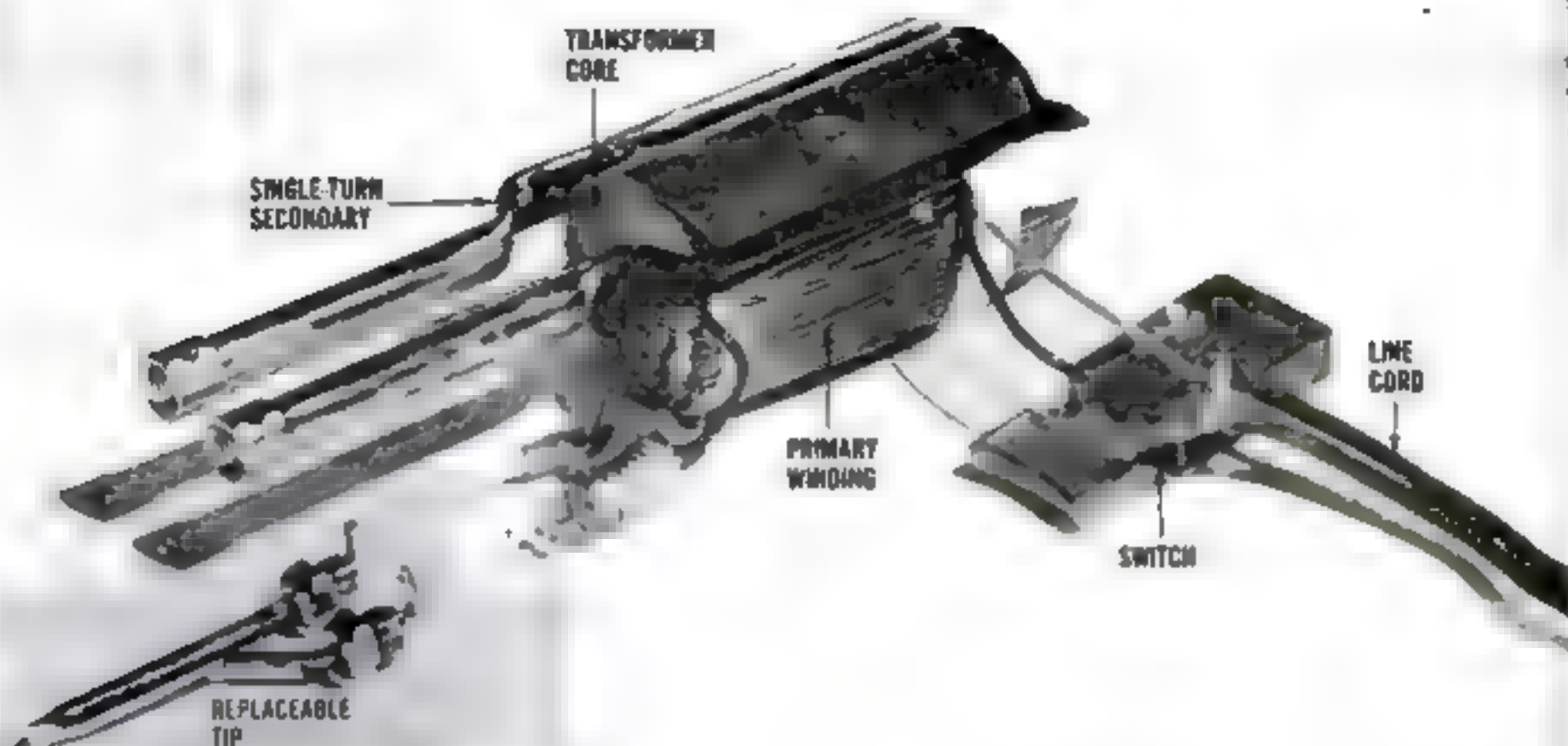
To understand the problems involved in inventing the soldering gun and to appreciate the elegant simplicity of the tool, you need to know something of the fundamentals of the soldering process itself. Soft solders form a bond by a solvent action. Part of the metal being soldered is actually dissolved by the molten solder and goes into solution with the solder to form an alloy different from the original solder. Join-

ing two pieces of metal by soldering is actually a chemical process rather than a purely physical one of adhesion.

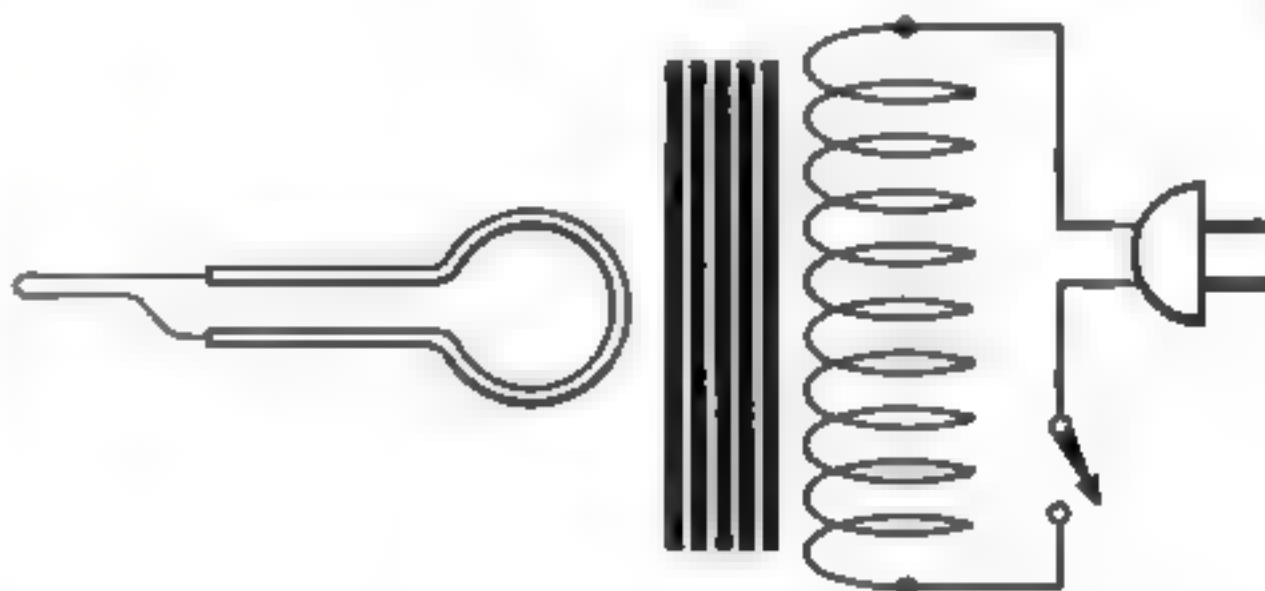
The role of the soldering iron or gun is not to melt the solder, as the common notion goes. The soldering iron's job is to heat the metal to be soldered to solder-alloying temperature. The metal must be kept hot enough to maintain the solder in a molten condition long enough for the alloying process to take place. (Of course, the molten solder must be in intimate contact with the metal; the metal surface must be clean; and a flux must be used to prevent formation of an oxide film on the hot metal.)

It is not enough for a soldering tool simply to get hot enough to melt solder. It must be capable of producing a sufficient *quantity* of heat to bring up to temperature the metal being soldered—and it must be able to transfer that heat efficiently and rapidly from the soldering-iron tip to the metal.

Imperfect understanding of these facts doomed many of the early attempts to make a direct-heating soldering iron. Because soldering irons—and most other electrically heated appliances—had always used a high-resistance alloy wire to obtain heat from electricity, the idea never occurred to would-



Coiled, flat ribbon of iron makes transformer core. To wind laminations through preformed wire coil, Weller invented a production machine. Real secret of gun's performance is copper-tubing secondary winding. It not only conducts heavy current without overheating, but acts as heat sink to cool upper end of hairpin tip and thus concentrate heat at soldering peen.



be inventors to try anything else. They tried to beat the warm-up time lag by using the resistance wire itself as the soldering tip to be applied to the work.

Some drawbacks to the scheme were recognized: With the current-carrying conductor in contact with the work, there was a shock hazard. Using a step-down transformer to feed a lower voltage to the resistance wire was a logical solution. But it couldn't be too low or there wouldn't be enough voltage to force enough current through the resistance to give enough heat. (Ohm's Law, $I=E/R$ —current equals voltage divided by the resistance; also, heating effect is determined by the equation, $watts=I^2R$.) So they still wound up with an uncomfortably high voltage.

But what really doomed this approach was something else: Alloys that make good resistance wire (poor electrical conductors) are also poor heat conductors. Although

the wire got hot enough, insufficient heat went into the metal to be soldered.

Weller, too, went through all these steps in perfecting his soldering gun—and ran into the same blind alley. Then his knack for ignoring the traditional solutions paid off. Instead of starting from the assumption that resistance wire was necessary to convert electricity into heat, he took off from the premise that a good heat conductor was necessary for the soldering tip. Practically, this meant using copper.

But no engineer in his right mind would even consider connecting a chunk of copper across a power line—it would be a dead short. The copper would get hot all right, but so would the connecting wires—hot enough to melt. Two problems had to be solved: 1) how to concentrate the heat at the soldering tip; 2) how to limit the current flow to a practical value.

[Continued on page 191]

These Dutch Boy House Paint Colors are different. Incredibly fade-resistant.

Starting now, you can use fresh, attractive colors on your house—from off-white to dark or bright—without fear of change or fading. That's because Dutch Boy Latex House Paint has a new kind of acrylic resin base, or "binder," which is much less sensitive to oxidation and ultraviolet light (the main causes of deterioration in house paints) than are the vegetable drying oils found in conventional paints.

Added to this, Dutch Boy Latex House Paint uses new types of color pigments, specially selected for stability.

And as it ages, there's no surface powdering to mask the color.

Put these three advantages together and it's easy to see why we can make this claim: Use Dutch Boy Latex House Paint without risk of perceptible color change, even after years of exposure.

In fact, Dutch Boy Latex House Paint retains its color so well you can come back and touch it up years afterwards and not see the difference. Think what that means in maintenance. To keep your house looking fresh and bright all you do is touch up the worn spots when they need it. In short, you may never have to paint your entire house at one time again.

You'll like using Dutch Boy Latex House Paint. (For all the reasons why, read what's on the back of the next page.)

A product of National Lead Company


**Now you can paint your house any of these colors.
They're all fade-resistant Dutch Boy Latex House Paint Colors.**



Sun-Ray Pink



Cobblestone Gray



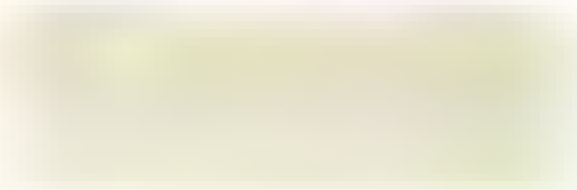
Bermuda Coral



Soft Blue



Warm Beige



Sandstone



Laurel Green




Light Beechwood Beige



Winter Wheat



Soft Gray



Desert Pink



Slate Blue



Cream



Gulf Aqua



Gunsmoke



Cascade Green



Cape Cod Yellow



Moss Green



Light Cream



Beechwood Beige



Caribbean Aqua



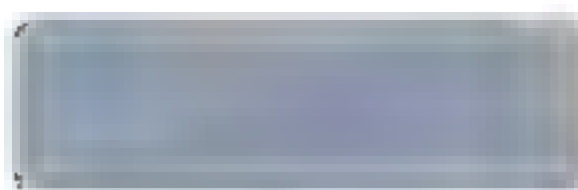
Balsam Green



Apple Green



Spring Willow



Quarry Gray



Rancho



Provincial Yellow



Woodland Oak



Charcoal Gray



Woodlawn Green

Save this card and keep it until you're ready to paint.



Dutch Boy Latex House Paint not only gives you color that lasts, it does much more:

It stays bright. Tests have shown Dutch Boy Latex House Paint to be outstandingly resistant to sunlight and oxidation. In fact, this paint retains its color so well you can touch it up years afterwards and not see the difference.

Cuts painting costs. The extremely high hiding power of this acrylic latex paint means it spreads further than conventional paints. You need less paint. And because the tough latex film has outstanding resistance to chalking and weathering you won't need to repaint for many years.

You don't have to wait for the weather. No need to wait for a dry spell to start painting. You can even use it right after a rainstorm if you like.

Covers almost any surface. It's the only paint you need for wood, stucco, brick, galvanized iron, aluminum, concrete.

Goes on more easily. Just like indoor latex paint, Dutch Boy Latex House Paint is astonishingly easy to use. And you can throw away all those cans of thinner. People, brushes, equipment all clean up with soapy water.

Leaves no lapmarks. With this paint you can stop, start, and stop again and no one will see the difference. This means you can spread your house painting over weeks if you like.

Like more facts about this remarkable paint? Ask your Dutch Boy dealer. He's in the Yellow Pages.

New Plastic- Mending Cements

how they work
and how
to use them

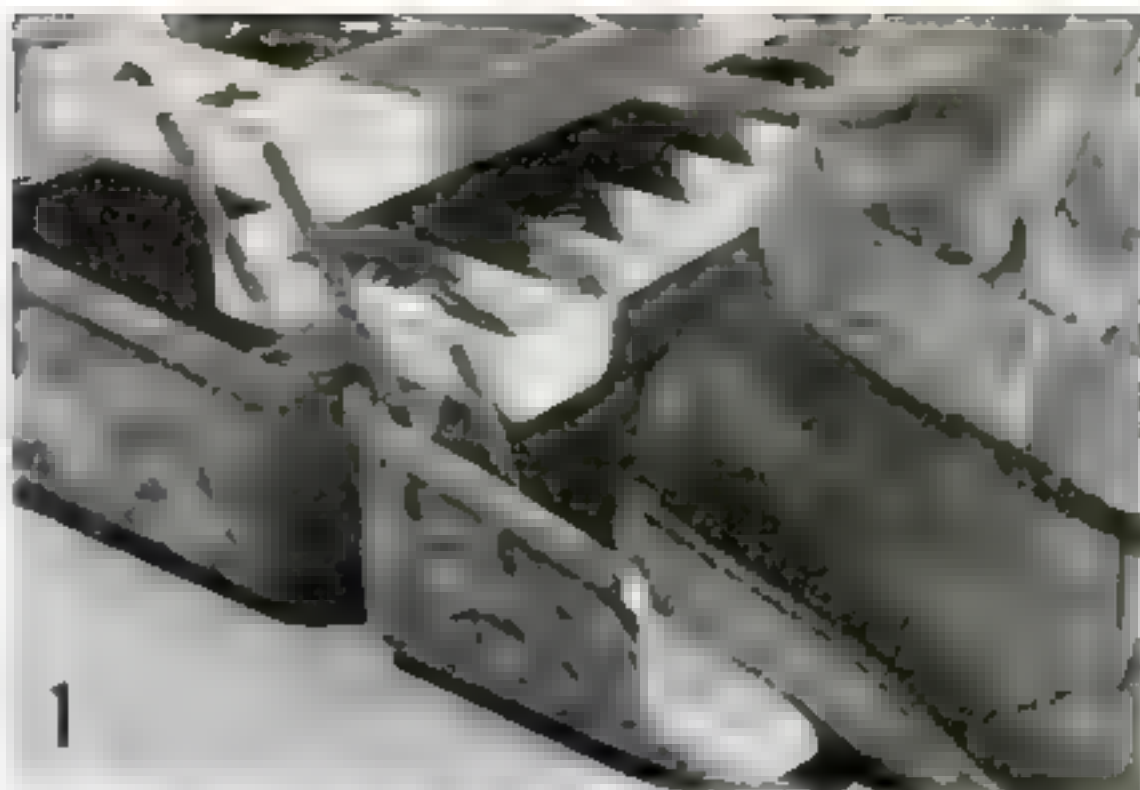
By Jackson Hand

THIS year, refuse-collection men should find fewer plastic objects in the household debris. Reason: A new adhesive now makes plastic repair routine. Acrylic, styrene, vinyl, phenolic—sheet or molded—rigid or flexible—all the common plastics (except polyethylene) respond.

Time was, when everything made of plastic was eggshell-easy to break. But most of it was so junky that it caused little pain to throw the stuff out. Then came expensive radios and cameras of plastic, car upholstery, rainwear, swim tanks. A hole in one of those put a big hole in the pocket. And there was no cure; nothing seemed to mend them permanently.

Now, for about 70 cents, you're in clover. The cements may be either viscous (like

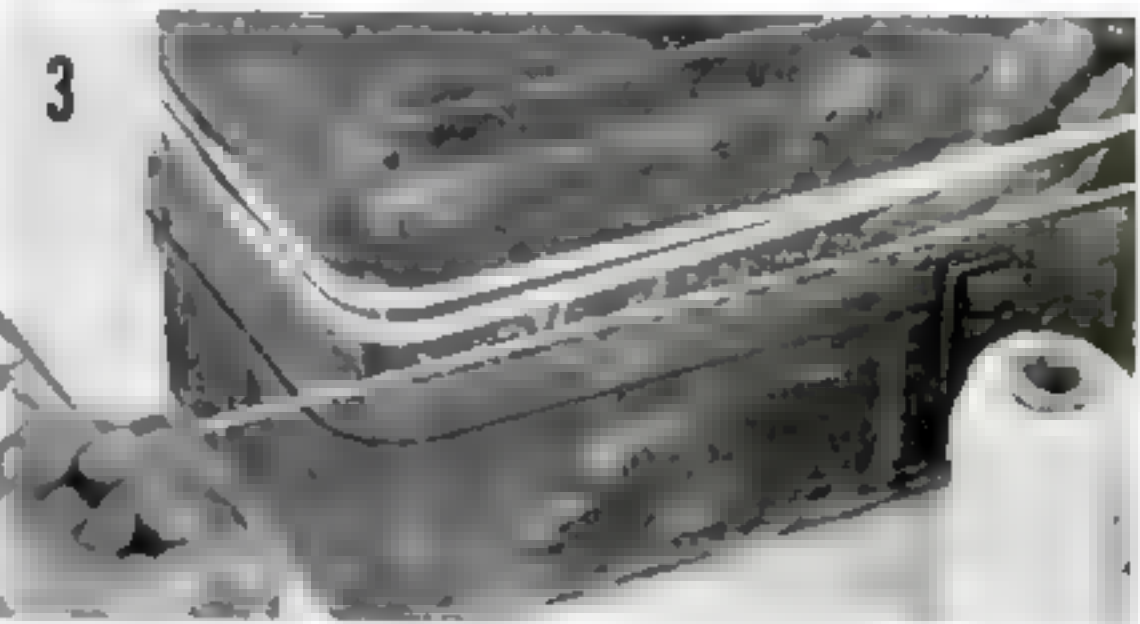
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Oops! Even an "unbreakable" plastic box has limitations.

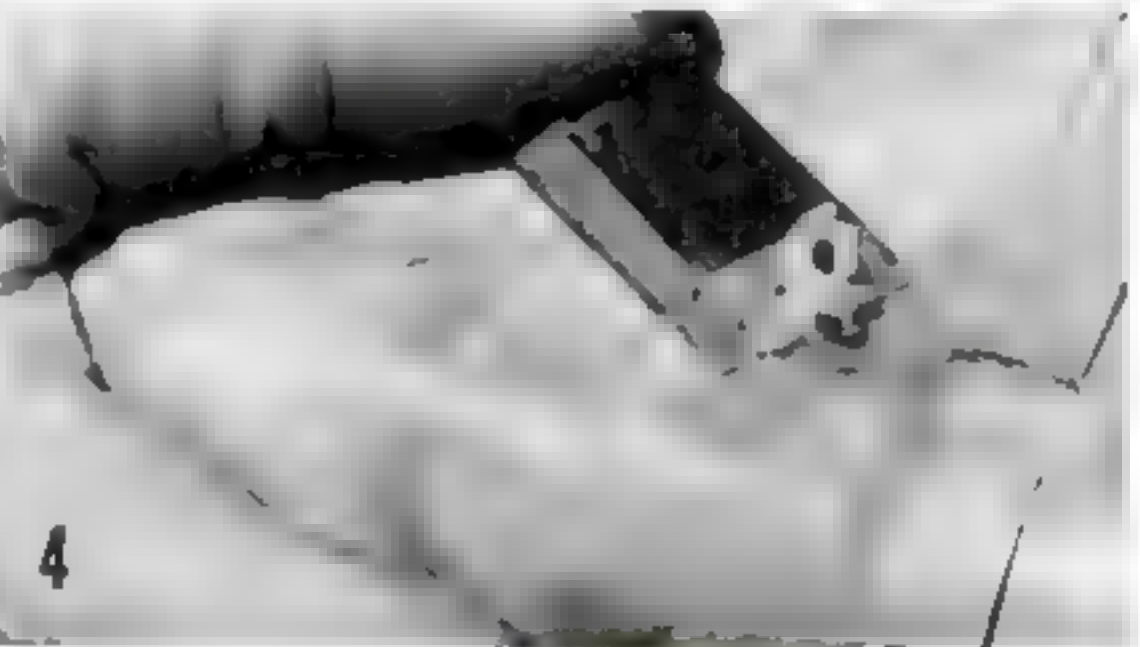


To repair, coat both edges of break with plastic cement.



Bind with strong cord or rope and let stand to cure.

Shave off excess cement with a chisel or razor blade.



Du Pont's Plastic Cement) or relatively thin (like Devcon's Plastic Mender). Both kinds take 24 to 48 hours to cure thoroughly—all the solvents must evaporate before the residue becomes solid. With rigid plastics, or metal and glass, even longer curing is better.

At first whiff, the new cements may remind you of "household cements." But the similarity is only whiff deep. The plastic cements are far more complex. A blend of several solvents, they'll soften a wide variety of sheet plastics without curling the material too much. There's no softening of hard plastics, but the resins in the cement bond tenaciously to them. And the plastic cement decides which solvents to send into action—you don't even have to know what plastic you're mending.

Always make sure surfaces are clean. On some types of vinyl, the surface may have a chalky appearance. Wiping with a soft cloth—or gently sandpapering—will help.

To test before a repair, squeeze a drop of cement in an inconspicuous place. If 24 hours later the drop stays stuck, go ahead with the mend. If the drop peels or rubs off easily you may be up against one of the stubborn plastics.

The plastics that can't be mended with the new cement are rare. Polyethylene may balk—but 99 times out of 100 when it's plastic, plastic cement will fix it.

Try these how-to tips when you're



Always immobilize bonded parts until cement has cured. Clothespins are good to hold continuous seams of semirigid and soft plastics.



To bind windings of rope, cord, or wire (as in this electrical coil), pour a line of cement along the top so that it runs between the coils.

Shop Notes on the New Plastic Cement

Plastics that you're unable to mend with plastic cement include: polyethylene, Teflon, silicones, nylon, Delrin acetyl plastic, and polypropylene. Although plastic cement may make some of them sticky—gummy on the surface—neither it nor anything else available to consumers will make them stick.

Plastic cement is easy to use, yet there are certain mistakes that can lead to failure. Experimentation has developed techniques that help guarantee good results:

- Apply the cement to both joining parts—and no fooling. Chemical wetting of the surfaces is important. You must not expect one side to wet the other, for a skin starts forming almost immediately and interferes with the transfer of cement.

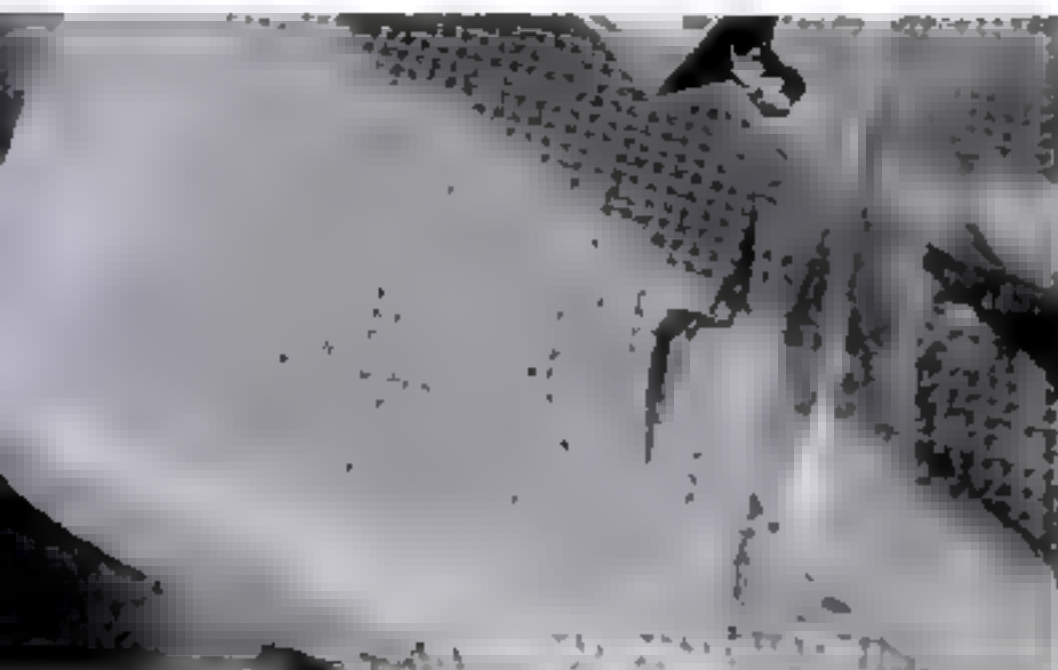
- Keep the joined parts immobile until the cement has completely set. This is important because the solids are weak, without elasticity, between the time the solvents evaporate and the resins harden. Do not test the joint to see if it's holding.

- Clamping is not essential, and often impossible. But plan how to maintain immobility—clothespins, tape, or rubber bands. Even gravity will sometimes do the job, when the piece is stationary.

- Work for the thinnest possible glue line, not only for good looks, but to make the best joint. When you cement thin sheet materials, use cement sparingly to prevent wrinkling and curling. Otherwise it's harder to position the parts and hold them together.

- Molded, rigid plastics can build up stresses during the original hardening and curing. When they break, the stresses distort the edges, so the pieces fail to fit back together precisely. Binding with cord or rubber bands often will pull the stressed edges into contact. Give it extra time to

working with plastic cement



Need an easy repair for a rip in upholstery or other plastic fabric? Apply cement around the tear and patch with a clear plastic film.



To mend irregular shapes that roll or teeter on a flat surface, brace them in a pan of sand as you work, and during the curing stage.



When mending seams in plastic rainwear, press them together and hold them a few seconds. They'll usually hold without clamping.



Aluminum foil keeps cement off fingers. Leave it a while to avoid disturbing the mend. Don't wait too long, and it peels off easily.

cure, or the stresses can break the joint. If the joint requires excessive pressure to close, try filing or paring the plastic.

- Don't expect miracles—just good adhesion. You may be able to peel a lapped joint of sheet plastic. But, in actual use, the strain on a lap joint would be tensile shear, not a direct pull. When a sheet is lapped only a tiny amount, the joint, if stretched, will be as strong as the material. But it will tear as easily as the material, too. Butt-edge joints in molded plastic, similarly, will not withstand flexing—but flexing is not the normal strain.

- When you're cementing to such impermeable materials as glass, metal, and phenolic plastics, you must allow a long time for the resins to cure, since the solvents will evaporate slowly. A glass bond, for example, may take a week for ultimate strength, although it will be strong enough for gentle handling in 48 hours.

- Some brands of plastic cement are packaged with a small patch of sheet material. You can add to this frequently in-

adequate supply with small pieces trimmed from excess material at the seams, or from certain kinds of plastic bags. Even when the item is colored, or patterned, clear plastic makes an invisible job.

- Excess cement on sheet patches is usually invisible. Any excess on molded or rigid work is easy to trim off with a razor blade. After it has hardened several days, you can sand and polish the cement solids that remain. When hard, the cement is a close chemical cousin to Lucite, and you can handle it the same.

- The shrinkage, as the solvents evaporate, is relatively great. So don't expect to fill gaps with plastic cement unless you build up enough to gain a smooth surface.

- One of the basic solvents in the cement is toluol. Along with others, it presents some hazards. The wet cement may mar the surfaces of furniture and the polish of some plastics. Keep it away from them for at least 48 hours. The solvents dry the skin. To keep your skin from cracking, avoid prolonged contact.



what's new

PHOTOGRAPHY

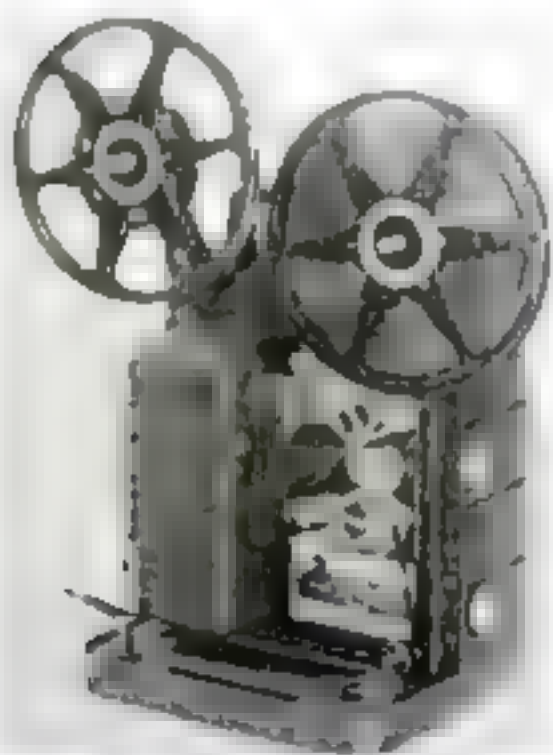
Zoom-lens movie camera is all automatic

The new Minolta Zoom 8 includes features that are fast changing the habits of movie fans. Four inexpensive penlight batteries power the camera. Each set will last through 10 to 12 rolls of film.

A sensitive cadmium sulfide meter sets exposure automatically. It adjusts to the field covered by the zoom lens. The meter can be disengaged for manual control.

The camera has through-the-lens focusing, and either right- or left-hand control of the 10-30mm f/1.8 Rokkor lens. A ground-glass center screen aids focusing,

and a pointer in the finder shows exposure. For remote control, you remove the hand-grip and plug in an accessory electric cord. Price of the new Minolta: \$159.50.



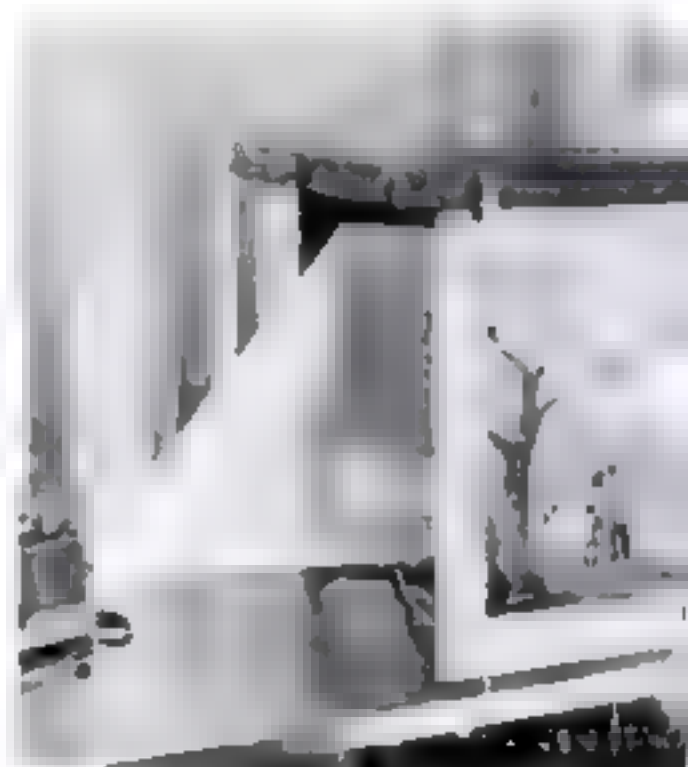
Auto-load 8mm projector at a moderate price

For the budget-minded, Bell & Howell offers the automatic-threading 8mm movie projector shown above. The 256 includes forward, reverse, and still controls on a single lever. The gear-driven reel arms fold flat for storage. There's a built-in film cutter. Price: about \$80.



Rapid-sequence flash gun holds five AG bulbs

Flip a finger and this doughnut-shaped flash gun bangs off five AG bulbs in quick succession as a spring-operated revolving magazine advances new bulbs into shooting position. Clear and blue interchangeable prismatic lenses give even light. \$11.95. Kling Photo, NYC.



Rear-projection screen folds flat in case

This portable rear-projection screen is large enough—18" by 24"—for group showings of up to 50 people, yet folds flat into a 3"-by-24"-by-31" case. The Groupshow operates with any projector. Price: \$95. Hudson Photo Industries, Irvington on Hudson, N. Y.

PHOTOGRAPHICALLY SPEAKING

By Bob Hering PS PHOTO EDITOR



Questions about Polacolor? Here are the answers

We decided to devote this month's column to answering questions that readers are asking about the new Polacolor film. The chances are that by now your local dealer has received a limited supply of the film. Polaroid tells us they expect the film to be available in limited quantities throughout the country by mid May. Some dealers, of course, may be unable to fill the demand.

If you're still wondering just what's needed to convert your Polaroid camera for color, check the chart below. It summarizes Polaroid's recommendations.

Starter pack. Polaroid markets a starter pack that includes two six-print rolls of Polacolor, slip-on cutter-bar "teeth," and detailed instructions for your camera model. Type 48 pack (3½" by 4½") sells for between \$9 and \$11; Type 38 (2½" by 3½"), \$7.50-\$9.

Film speed and developing time. Polacolor is unlike conventional color. The camera temperature affects the processing time and film speed of Polacolor. At first this may be confusing. You can, however, move from a heated room to cooler outdoor temperature, shoot a picture, and return immediately to process it, using normal film speed and developing time. You should avoid processing below 45 degrees. In general, above 60 de-

CONTINUED



What You Need to Take Pictures with Polacolor

CAMERA MODEL	FILM TYPE	NECESSARY ACCESSORIES	FLASH GUNS AND BULBS FOR INDOOR PICTURES	RECOMMENDED ACCESSORIES
95	48 (3¼" x 4¼")	Cutter-bar teeth #274	#200, 201, 202—press 25B (blue); #270—M3 (white)	Processing timer #120
95A, 95B, 100, 700	48 (3¼" x 4¼")	Cutter-bar teeth #274 or 274L*	#200, 201, 202, 203, 240—press 25B (blue); #270—M3 (white); Wink-light #252 and flasher—AG-1B (blue)	
110	48 (3¼" x 4¼")	Cutter-bar teeth #274	#221, 222—press 25B (blue); Wink-light #251 and flasher—AG-1B (blue)	Polaroid exposure meter #625 or other meter
110A, 110B, 120, 800, 150, 160	48 (3¼" x 4¼")	Cutter-bar teeth #274 or 274L*	#281—5B (blue); Wink-light #250 and flasher—AG-1B (blue); #269—M3 (white)	
850, 900	48 (3¼" x 4¼")	Cutter-bar teeth #274 or 274L*	Wink-light #250 and flasher—AG-1B (blue); #269—M3 (white)	Processing timer #120
J66	48 (3¼" x 4¼")	Cutter-bar teeth #274L; #660 color-adaptor kit**	J-5 flash reflector—M3 (white)	
J33	38 (2½" x 3¼")	Cutter-bar teeth #273L; #330 color-adaptor kit**		
80, 80A, 80B	38 (2½" x 3¼")	These cameras should not be used with color film until they have been modified by the factory.		

*Both versions are packed together

**Contains electric-eye adaptor, UV filter, J-5 flash reflector

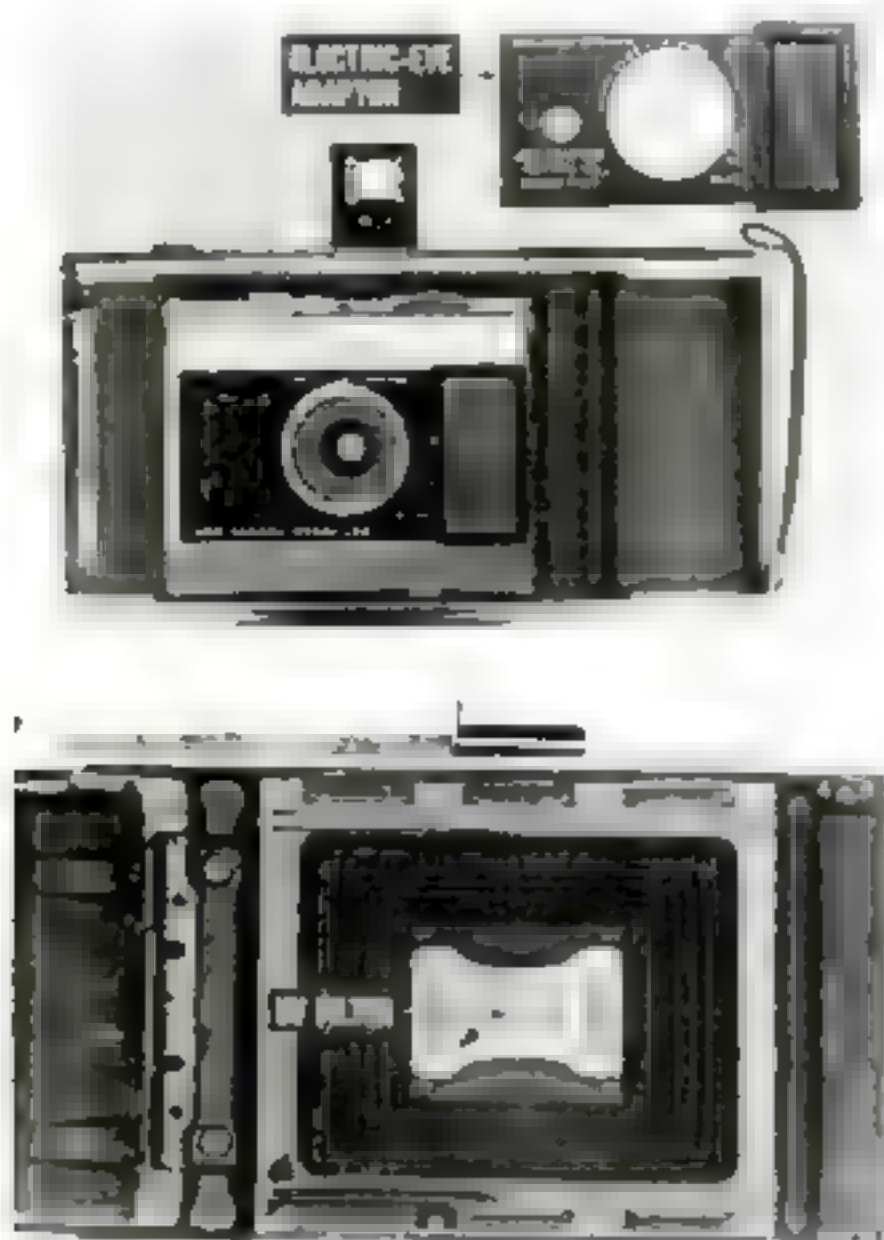
Note: Polaroid Print Copier cannot be used with color film

PHOTOGRAPHICALLY SPEAKING

degrees, use a film speed of 75 ASA and develop for 50 seconds. For precise results, use this table:

TEMPERATURE	SET METER TO ASA	DEVELOPMENT TIME
100°	100	40 seconds
75°	75	50 seconds
60°	50	60 seconds
45°	25	90 seconds

Coating. When I first tested Polacolor several months ago, I had to coat the print no less than five seconds after removing it. This was tricky. The film muddled quickly.



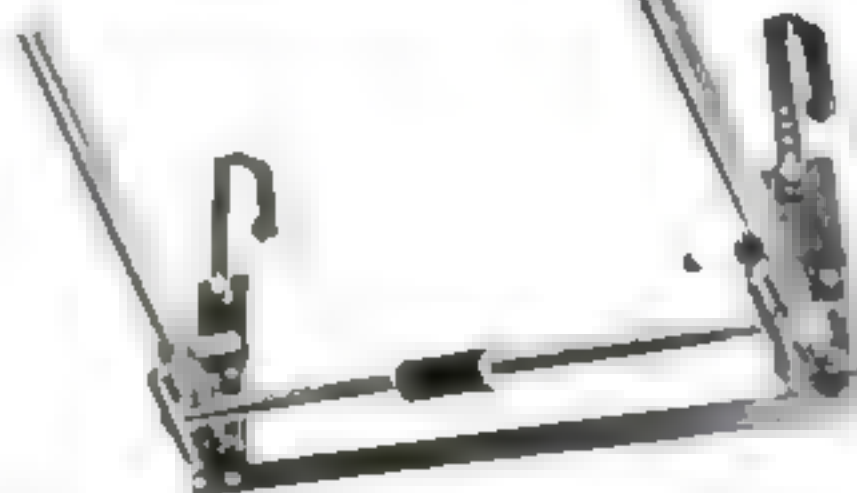
Polaroid fortunately put through a crash program to eliminate the coating step.

Filtration. Polacolor is a daylight film balanced for 6,250 degrees K. Indoors you must use blue flash bulbs, clear bulbs with a blue shield, or electronic flash. You can use the same filters for this film as you do for conventional daylight color films. Later, when production experience eliminates the variables, Polaroid will give specific filter suggestions. Meanwhile, if you wish to experiment with changing the overall color, try one or more CC filters for almost any color correction. ■ ■



New finder shows left-right heading

A new transistorized direction finder features a left-right meter indication of the boat's heading. It also has an automatic noise limiter and circuitry for reception of new Consolan signals. It operates on three bands: beacon, standard broadcast, and marine. Price is \$249.50. Sonar Radio Corp., 73 Wortman Ave., Brooklyn 7, N.Y.



Easy-to-install motor tilt

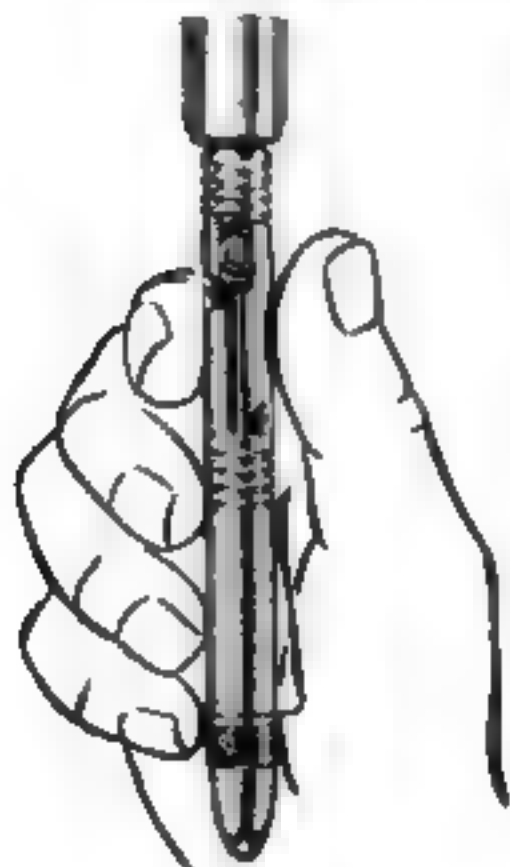
New Tilt-O-Matic clamps on the transom and, at the push of a button, instantly raises and lowers the outboard motor. It's powered by a rechargeable CO₂ cylinder that gives approximately 50 complete tilting cycles. Price: \$74.50 for the standard model, \$89.95 in chrome. National Marine Corp., 114 West Indiana Ave., South Bend, Ind.



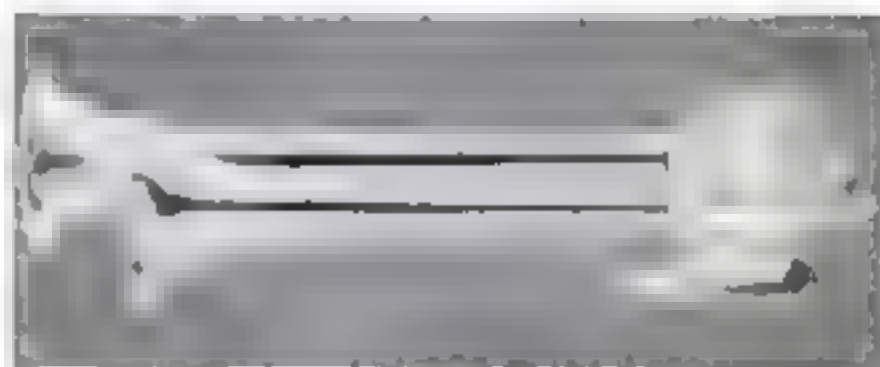
New Aluminum Engines Cut Weight in Half

THE new all-aluminum Graymarine engines reduce engine weight by half. Weighing in at as little as 390 pounds (for installation with MerCruiser outboard drive), they are ideal for stern-drive installations such as the Eaton Powernaut shown above. This stern-drive model with Graymarine fresh-water cooling system and all hydraulic gear is only 490 pounds. The V-8s are built in two output sizes: 136 hp. with two-barrel downdraft carburetor, 160 hp. with a four-barrel downdraft carb. The engines come with a 40-amp marine alternator, heat exchanger and sea-water pump, disposable canister-type oil filter, and fuel filter. Prices vary with horsepower. Gray Marine Motor Co., Detroit 7.

A rocket for your pocket



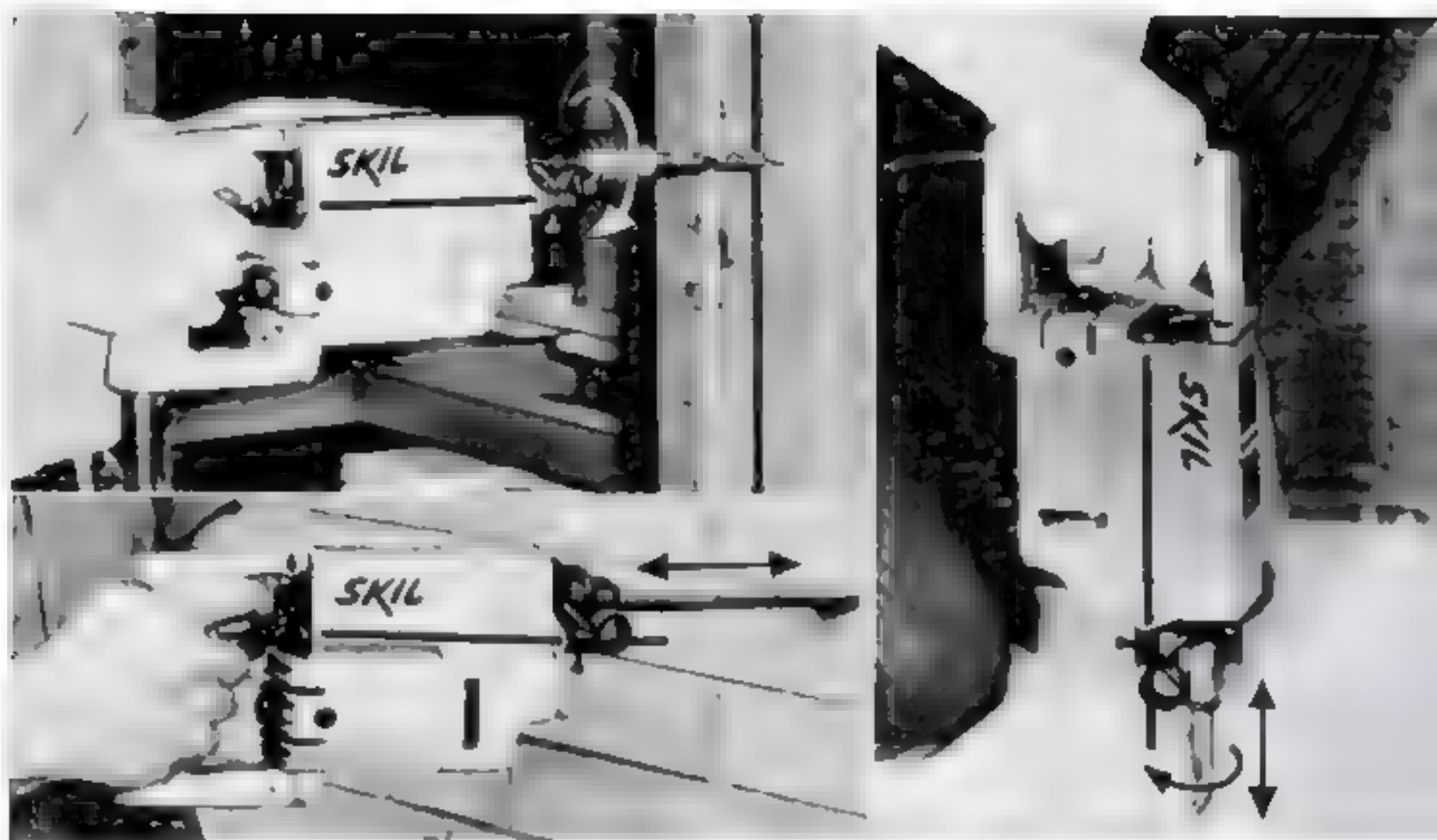
A new pocket signal-flare pistol is only 5" long, $\frac{1}{2}$ " in diameter, and weighs 1 $\frac{1}{2}$ ounces. The cartridges load easily, fire flares to an altitude of 300 feet. Price is \$15.95 prepaid for a kit including flare pistol and nine cartridges (three each of red, green, and white). Scot-Air, Inc., 6451 Main St., Morton Grove, Ill., sells the kit.



Small horn with big voice—Freon blows it

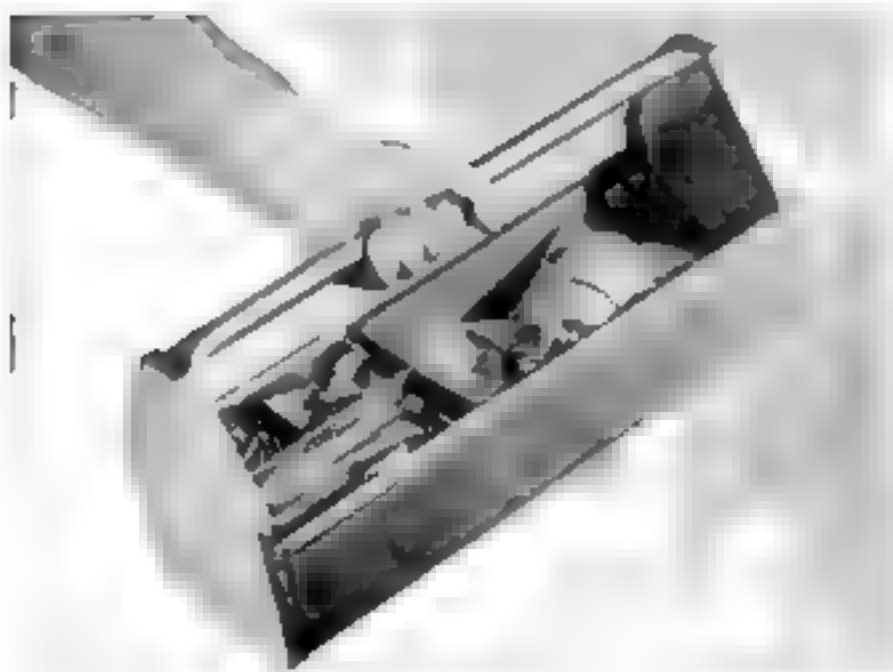
A new horn for boats of all sizes has a "liner's blast" although it measures only 16 $\frac{1}{2}$ ". It's powered by a two-pound Freon cartridge, activated by a solenoid-controlled valve. Price is \$29.50 from Hadley Mfg. Co., 2221 Albion St., Toledo, Ohio.





Triple-Action Tool Drills, Hammers

Lightweight Roto-Hammer combines rotating and hammering actions. A rotating cam alternately compresses and releases a spring. To use combined action (above, right), the spring's energy drives bit in and out at same time it rotates. For rotary action only (top, left), a special adaptor engages the rotary drive but not the spring. For hammering (lower, left), another adaptor engages spring but not rotary drive. Tool is designed for jobs where larger hammers are not practical. Price is \$169.50. Skil Corp., Chicago 30



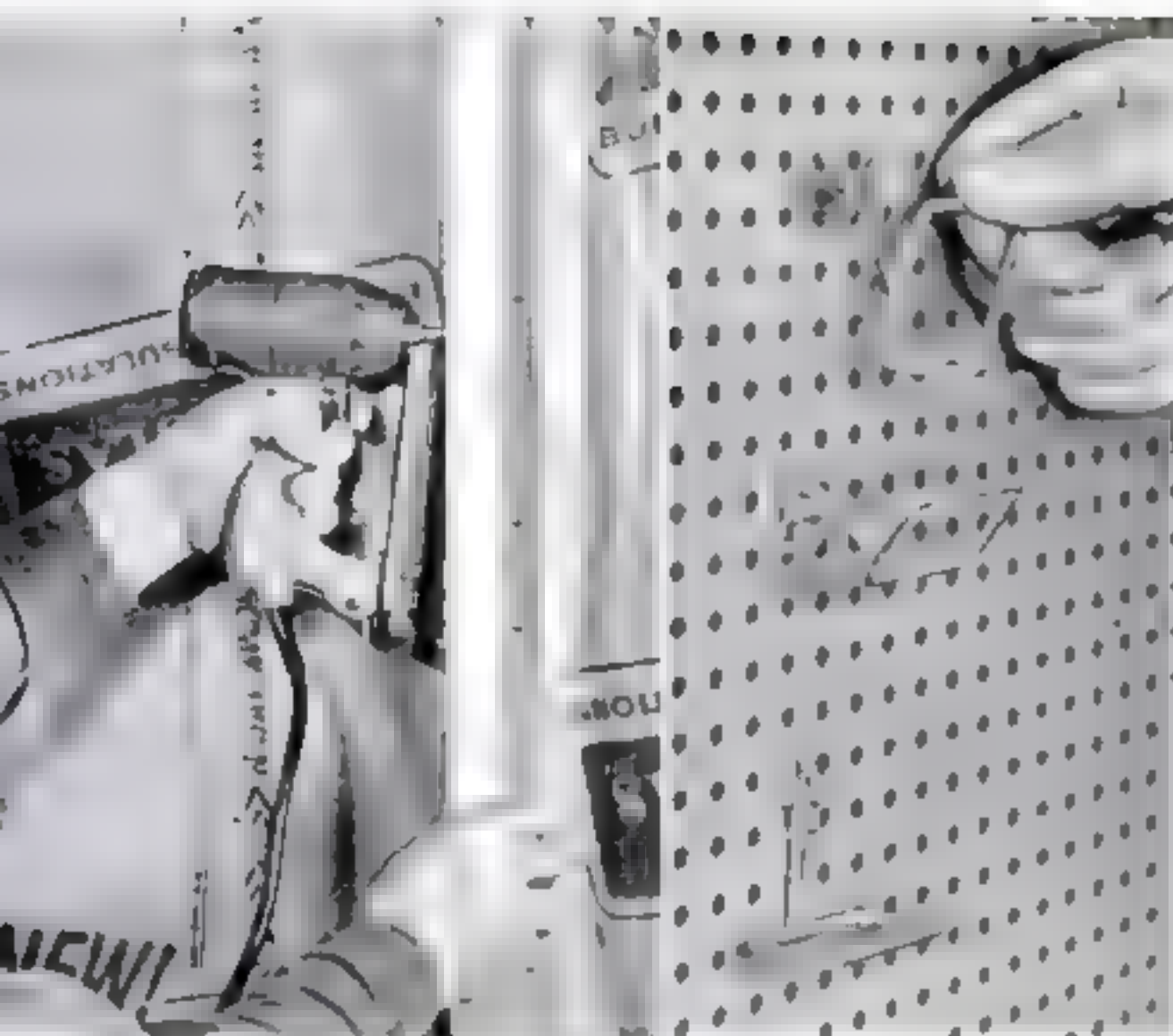
Portable drill kit saves steps

For the home craftsman who wants all the accessories for his electric drill in one kit, the Toter tool kit should save many steps. It includes such accessories as a grinding wheel, nine twist drills, 3" wire brush, paint mixer, polishing bonnet, tool stand, and sandpaper disks. Price: \$9.95. Wen Products, Inc., Chicago 31.



Sanding belt for a portable drill

Fasten a strip of common sandpaper to the Barco flexible sanding belt, attach it to your 1/2" portable drill, and you have a rapid sanding tool for smoothing curved surfaces. Adjustable clips hold sanding strip on neoprene belt. The sanding belt has a short, straight-line, back-and-forth action. \$4.95. P. L. Bahr Co., Box 246, Vienna, Ohio.



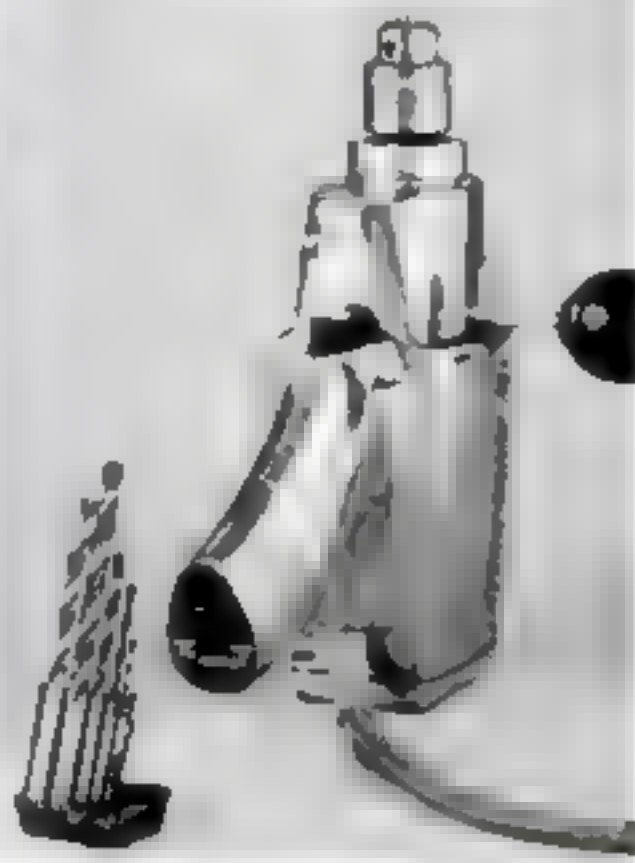
New electric stapler speeds tacking jobs

The Duo-Fast stapler sets up to 300 staples per minute. Designed for use where compressed-air supply is impractical, tool runs on house current. \$85. Fastener Corp., Franklin Park, Ill.

Locking hooks give more stability

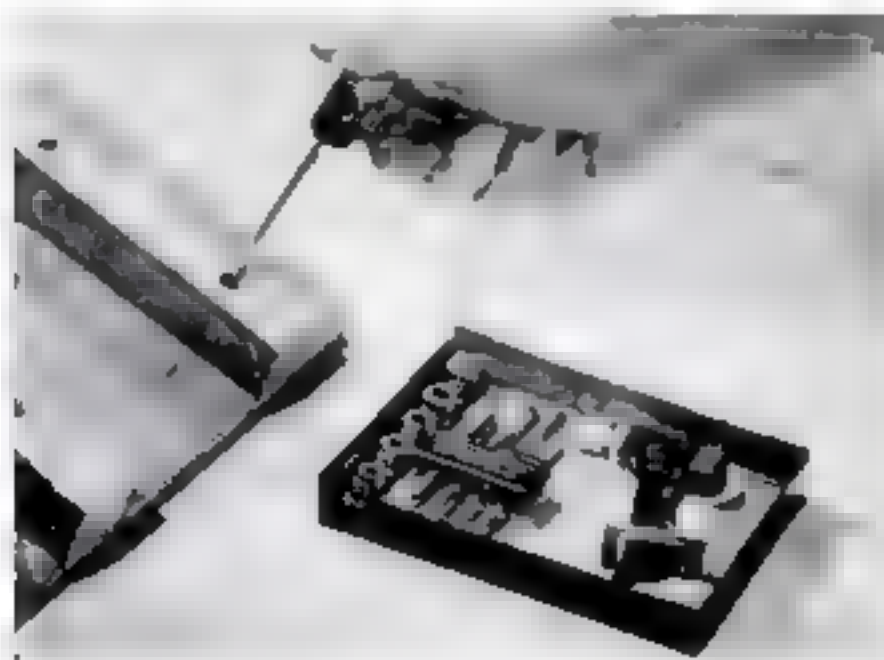
Self-locking pegboard hooks reduce side wobble and resist pull-out. A special spring clip is a part of every hook. Six hooks in a plastic pack cost 49 cents. Peg-Lok, Inc., Cumberland, R. I.

what's new TOOLS



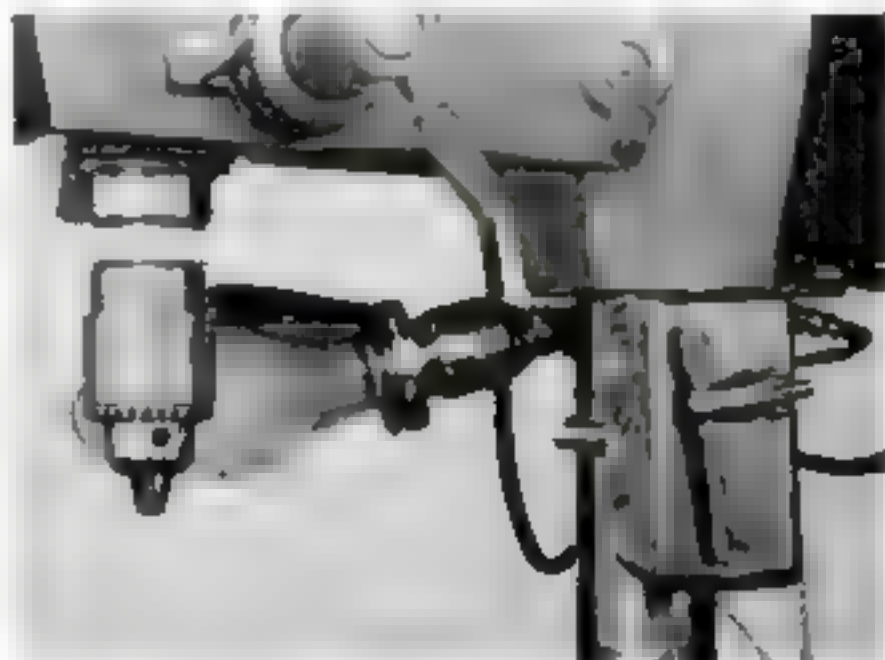
Electric-drill handle holds extra bits

A plastic cartridge for the new Powr-Kraft $\frac{1}{2}$ " drill holds 10 standard-size bits and snap-fits into the handle. Its end is the butt plate of the drill. It sells for \$21.88 at Montgomery Ward.



Reversible pistol-grip screwdriver

Handy for working in tight corners or at odd angles is Oxwall's new pistol-grip ratchet screwdriver. A flick of the finger changes the action to left, right, or neutral. The pistol-grip handle increases turning power. Five-piece set, \$1.98. Ten-piece set, including sockets, \$2.98. Oxwall Tool Co., Flushing, N. Y.



Switch averts flying chuck keys

With this attachment, the chuck key must be placed on a safety switch before the motor will start. Two magnets hold the key securely. It makes a safety interlock, eliminating the possibility of a forgotten key flying off and hitting someone. Switch sells for \$8.95. Ellison Instrument Co., 65 E. Route 14, Crystal Lake, Ill.

veloped now. Storage batteries, possibly recharged by solar cells, could power electric motors. Special wheels, already designed on paper, could negotiate rugged mountains and deep moon dust.

What still stumps the engineers is a purely human problem: tailoring the remote controls to the "drivers." Guiding a vehicle electronically is extremely demanding, as I discovered during the seven runs I sweated out.

I first tried a low-speed (1.4-m.p.h.) and a medium-speed (3.1-m.p.h.) trial, both without time delay, as a warmup. It was unlike anything I'd ever tried before. There was a stick instead of a steering wheel, a constant-speed governor instead of an accelerator pedal, a flickering picture instead of direct vision, a rigid stool instead of a seat that moved with the weaving jeep. And no brakes.

Even so, the first two runs weren't too hard. At low and medium speed there was time to correct mistakes.

The feedback lag. The 2½-second delay introduced an irrational, nightmarish quality to my earthbound lunar trip.

Practically everything we do with our hands has an immediate result. A delay in the familiar cause-effect pattern causes uneasiness and frustration. Furthermore, the learning process is severely impaired by a lag in feedback; by the time you see the effect of your last action you've forgotten exactly what the action was.

Hagerman and Bill Obert-Thorn, a human-factors specialist at Grumman, have been trying a variety of control arrangements. They soon learned that the fewer tasks a driver has to perform, the better—for him and the vehicle.

They selected three constant speeds on the basis of trial runs—1.4, 3.1, and 4.25 m.p.h. A driver could then concentrate on steering, since speed was outside his control. An actual moon vehicle, however, might have a speed control so it could scurry over long, flat stretches.

Steering could be the familiar proportional type—in which the wheels turn at an angle proportional to the angle of movement of the control device. Or it could be "bang-bang"—an all-or-nothing type in which the wheels point only straight, hard right, or hard left.

Finally, the TV camera was rigged so it

could point ahead or pan with the wheels. This made 12 possible combinations.

My first experience with the time delay was at medium speed (3.1 m.p.h.) with proportional steering and fixed camera. I ran over five cones and went on the wrong side of four others.

The second run was also at medium speed with proportional steering; but the camera was linked to the front wheels to pan with them. This time I clobbered six cones, but stayed inside all the others.

Though this was better than my previous showing, I found the pan effect distracting. The camera seemed to swing over too far. And while it was aimed to one side I lost sight of the windshield latch, which I had been using to aim the jeep.

The third run, described earlier, was at high speed (4.25 m.p.h.) with proportional steering and fixed camera. I flattened two cones, outflanked two others.

On the fourth run I surprised myself and my Grumman mentors. This was a medium-speed, bang-bang steering, fixed-camera combination. With bang-bang the amount of deflection was constant at 30 degrees. I had to worry only about duration of the turn. Instead of shoving a clumsy stick, I flicked a small toggle switch. My score: one cone down, none outflanked.

High-speed, bang-bang. My fifth, and last, run was a high-speed, bang-bang, no-camera-pan combination. I really blew it. Whether from overconfidence, fatigue, or heavy ignition interference from a plane taking off nearby, I couldn't tell. But I squashed six cones and went on the outside of another.

I climbed out of the darkened trailer convinced that they had better provide plenty of replacements for the Lunar Roving Vehicle—and its driver. But Hagerman assured me he was working on a driving aid that would overcome the time-lag handicap.

"It's a mechanical analogue computer for constant-speed, bang-bang-steering control," Hagerman said. "It will superimpose a spot on the screen that indicates the jeep's position 2½ seconds later, based on present course and speed. You steer the spot instead of the front of the vehicle."

Even with such a predictor, moon-vehicle drivers will be busy, harried men. But here's one volunteer. Talk about armchair adventuring!

"Even squaw can carry"



New Johnson Compacts

So dependable, they all have a 2-year warranty!

Above is the Sea-Horse 3. Home in the teepee are three other power-packed papooses: the 18 (at right), 10 and 5½ hp models.

The spunky 3 has a built in fuel tank plus, as a new accessory, a fuel pump and separate 6-gallon tank to boost cruising time to 17 hours. The 18, 10 and 5½ offer thermostatic cooling, super silencing, cushion-hub prop and built-in gear shift.

The same 2-year warranty policy — good for parts and labor — also applies on the new 75, 40 and 28 hp models. For free catalog, write: Johnson Motors, 1364 Pershing Rd., Waukegan, Illinois. Division of Outboard Marine Corp.



How to Fit Out a Corvan as a Camper

[Continued from page 124]



a private vehicle and can go anywhere.

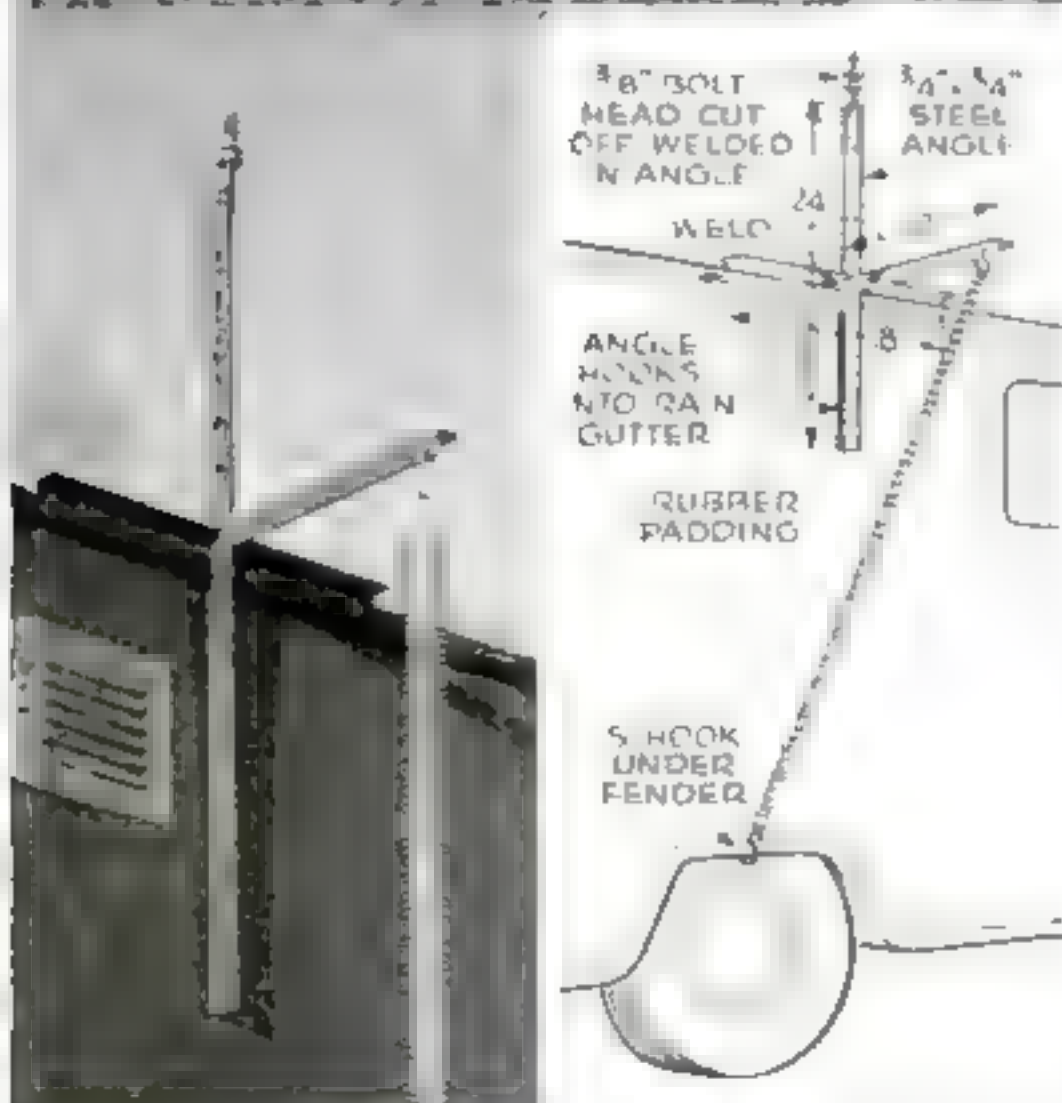
The installation job turned out to be easier than anyone guessed. Stock windows are available for this purpose at shops that handle auto glass and supplies. They consist of rubber moldings that simply hook into place after openings have been cut and framed in the van walls. How they work is shown in a drawing. Chatman added four in all—two on the door side and two in the opposite solid wall.

Fitting out the inside. Chatman decided to keep the furniture simple. Instead of elaborate built-ins, he chose a large ready-made dresser that provides 10 drawers of storage and fits across the van behind the front-seat partition. Its top serves as a counter.

Only one bed is permanently installed, and this doubles as a sofa by day. The other bed is set up on a folding plywood support that raises its front end level with the higher cargo deck at the rear. Both beds have 4"-thick foam-rubber mattresses.

For cooking, there's a two-burner propane stove and a portable charcoal grill. Other equipment includes a 10-gallon water tank, chemical toilet, small gas heater, and two plastic ice coolers—one for food, one for cold drinks. Washing is done in a plastic basin. A drain hole cut in the floor lets you dump dirty water through a funnel without going outdoors.

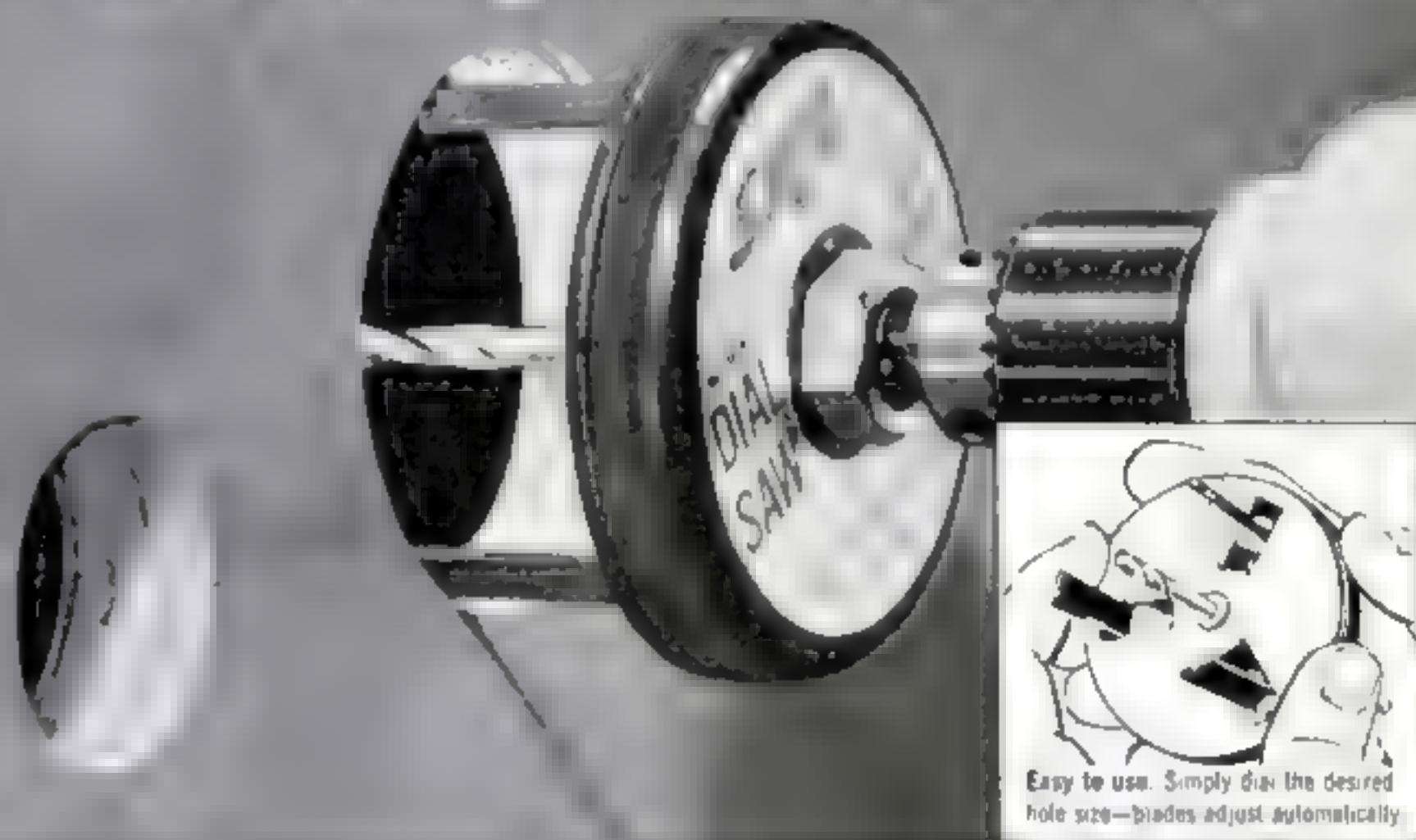
A 110-volt outlet on an extension cord is kept handy for plugging into power lines available at public campsites and trailer parks. With this, you can run a toaster, hot plate, electric shaver, lights, power tools—any standard household appliances. The interior is kept ventilated by a marine-type deck vent mounted on the roof and an exhaust fan on a rear wall. A two-section hinged panel at the top of the forward partition can be closed for privacy or opened to give the driver an unobstructed view through the rear of the van. Roller shades on the windows give full privacy throughout the camper. ■ ■



Rear edge of awning is supported by ingenious brackets that hook into the rain gutter. They're held in place by tension of long springs hooked under the fenders. Two nuts at the top allow the awning to be adjusted up or down until its edge fits snugly in the gutter.

FREE! \$4.95 DIAL SAW

for drilling holes 1 1/8" to 2 1/2"

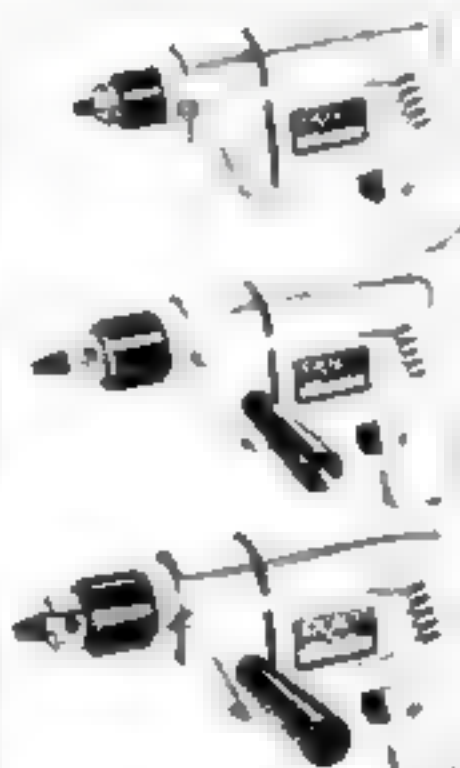


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Model 503D 1/2" Drill has a full 2.5 amp. motor that provides power to spare for drilling in concrete, metal, brickwork, plaster, wood or wallboard. Lightweight — only 3 lbs. Priced under \$20.

Model 5800 1/2" Drill has double reduction gears, powerful motor for greater drilling torque. Side handle gives extra control, removable when drilling in tight spots. Priced under \$35.

Model 5410 1/2" Drill — Most compact, low-cost 1/2 incher available. Gives big drill performance with small drill handling ease. Powerful 3 amp. motor, multi-ball thrust bearing for heavy-duty work. Removable side handle. Priced under \$37.



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They Fish for Diamonds

(Continued from page 47)

bles and water is lighter than the water outside the pipe, it flows upward—with such force it's carried high above the surface.

Meanwhile, nozzles on a "jet head" at the pipe's lower end squirt water jets downward. They stir up the sea bottom's gravel, and it gets drawn along with water rushing up the pipe.

At the top of the air lift the waterborne gravel starts through the barge's concentrating plant.

First it hits a "scalping screen" that strains out rocks and pebbles larger than $\frac{1}{8}$ inch in size. Back to the sea they go—after close scanning on a moving belt, in case of a huge diamond among them.

Next comes a "dewatering screen." It catches all the material to be concentrated—diamond-bearing gravel larger than 2 mm. (about .08 inch). Sand and water passing through this screen are rejected.

The gravel goes to an ultramodern "cyclone" separator that whurls it in a medium simulating a heavy liquid—water and ferro-silicon powder. Heavy minerals, diamonds included, sink to the bottom and are drawn off. Light ones (tailings) rise to the top.

In a ball mill, shells and other friable material of the heavy-mineral "fraction" are now ground up and screened off as sludge. Pleitz jigs, long used to recover diamonds from desert sands, eliminate as much remaining foreign matter as machines can. Then the paydirt goes to keen-eyed sorters who pluck out the gems.

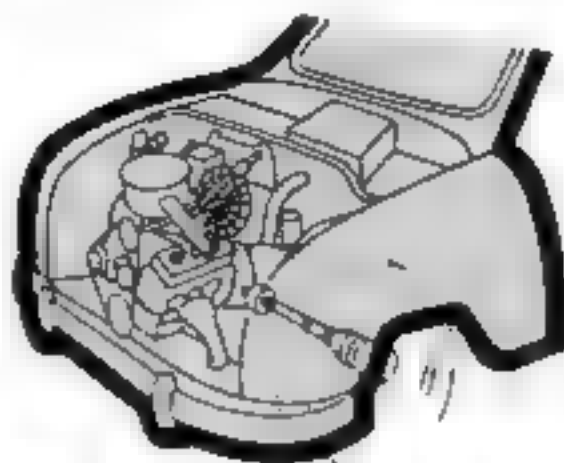
The undersea stones are definitely of gem quality. For its rough, uncut gems, Marine Diamond gets about \$40 per carat.

How did the diamonds in the sea get there? Asking that question is a good way to start a debate among geologists.

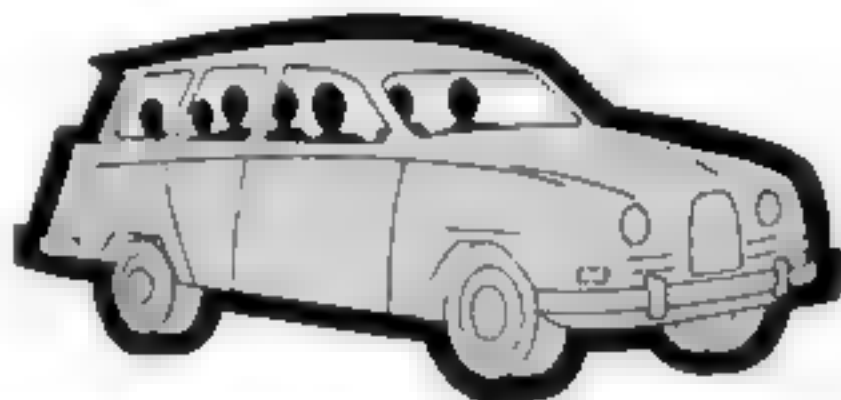
On land, diamonds occur in "pipes" of blue-green kimberlite rock—the volcanic lava that brought them to the surface—and in alluvial beds, where rivers carried them from the weathering pipes. Did rivers, ancient or modern, deposit the diamonds now being mined offshore? Or were submarine pipes the source of the sea-bottom gems, as Marine Diamond's chief geologist suggests—and, perhaps, of the coastal beds, too?

Which answer may be right doesn't trouble Sammy Collins. Smilingly examining the choice stones in Seventy Seven's latest haul, he observes, "We are quite pleased with the whole operation." ■ ■

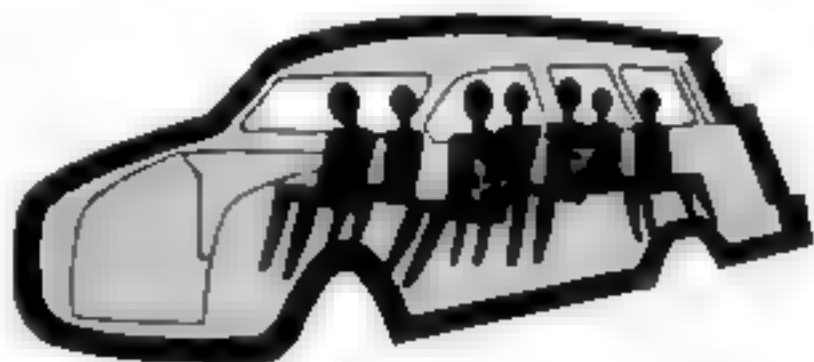
1963 SAAB ... built so well



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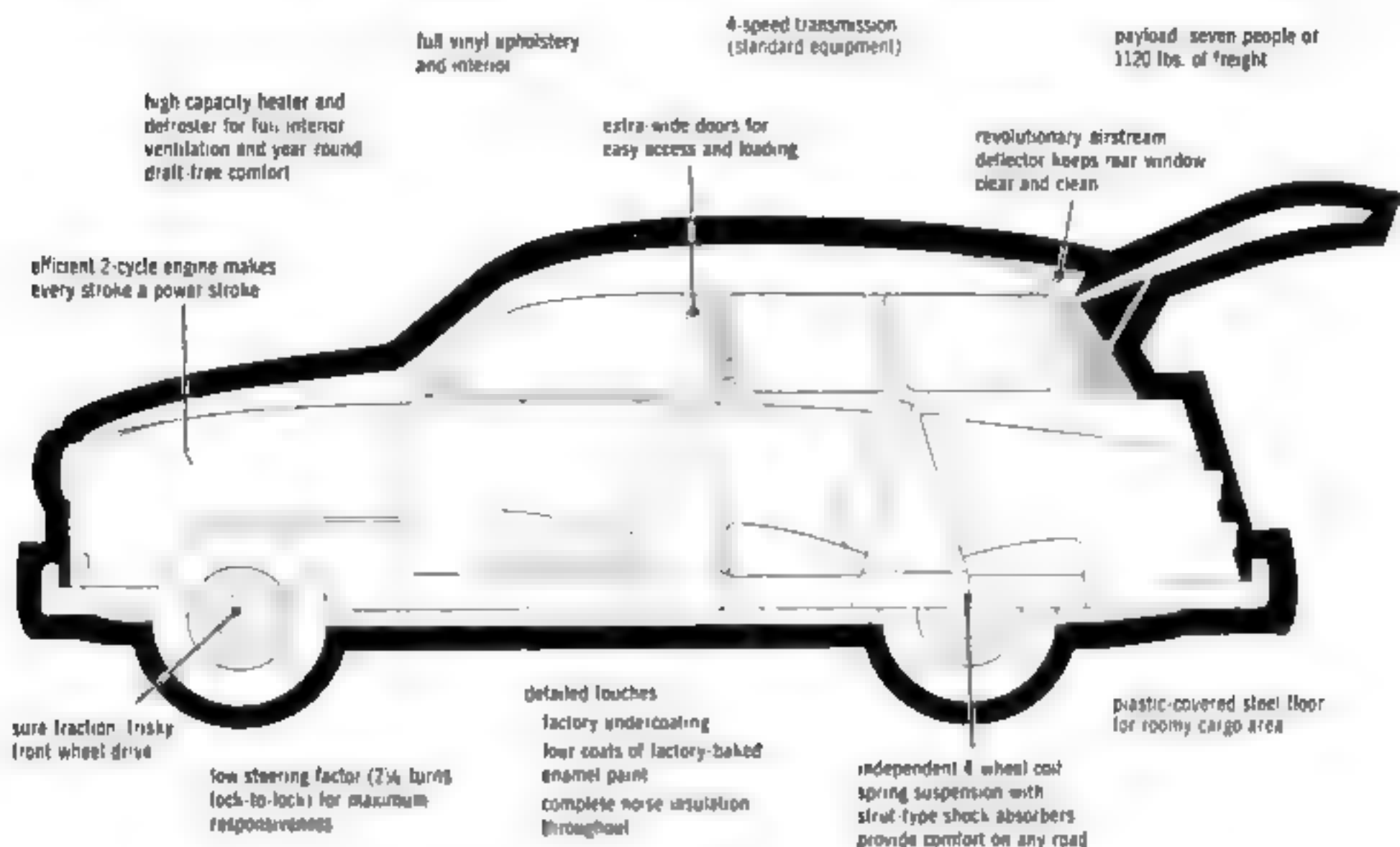


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Jim Roe Tests the Lone Star Cruise Liner II

(Continued from page 101)

sea." This was no fluke, I'm sure. My years of rigging and testing boats have convinced me that Johnson motors are always ready to go the moment you take them out of the shipping case.

Power to spare. Their fast pickup power scooted the Cruise Liner II out into Mobile Bay in a big hurry. Top speed for this boat-motor combination is more than 35 m.p.h. I've operated four-cylinder 75-hp. Johnsons like these for several years, so I was not at all surprised to feel the thrust when I pushed the throttles toward the wall. Earl Glenn, of the Lone Star Company, was caught a time or two in the cockpit—when I failed to warn him—and testified that the pickup literally took him off his feet.

With this kind of power, you can get a whole flock of skiers up all at once. Or head for the barn in a hurry if unfriendly clouds loom over the horizon—as they were doing most of the time we were out. We kept a constant check on the approaching weather with a Zenith 790 Royal Navigator radio. We tuned it alternately from the New Orleans to the Pensacola FAA aviation weather advisories on the long-wave band, and used plug-in earphones so we could hear the weather even when operating the engines at speed.

Easy control. But the weather got no worse, so we were able to put both boat and motor through all the paces we had planned. I was particularly pleased with the ease of handling and the responsiveness of the new Electramatic single-lever controls. They are so well tuned we even approached a dock at one point using the engines as our only steering device. By varying their speed and by operating one motor in forward and the other in reverse, we were able to maneuver very well and make a near-perfect approach to the dock.

The single levers operate electrically, sending impulses to clutch springs in the lower-unit gear case (there are two springs there—one for forward and one for reverse). When the lever is in neutral, the clutches rotate freely around the hub. When the lever is moved into gear, an electric coil magnetically causes the spring to grip the clutch hub. Power for this is supplied by the 20-amp alternator-generators on the motors. These kick out full amperage at half throttle, and put out several amps even while idling or trolling.

A few faults. I have never yet operated a boat that I would say was absolutely perfect in *every* respect. The Cruise Liner II, though an outstanding boat, is no exception. Happily, most of the changes I'd like could be made rather easily. Sharp corners, for instance. There are several inside the cabin, particularly around the bow hatch. They are no big problem in calm water and with slow movements, but can become quite different in rough conditions. I'd recommend padding them. I'd also apply some nonskid paint on the bow deck.

A point the thoughtful boatman will do well to keep in mind: This is an able boat, superbly outfitted, and quite safe for its intended usage. But no 24-foot outboard is intended for big-sea conditions. And the aluminum that makes her light and easy to launch and recover also makes her more responsive to a sea.

Boat manufacturers are now building so many fine conveniences into medium-size and small boats you have to be careful they don't make you think you're skippering an ocean-going 40-footer.

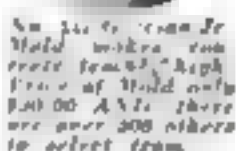
Rain or shine. Our Mobile Bay run gave us a chance to see what the Cruise Liner II was like in heavy rain. Lots of boats are strictly fair-weather craft. Even a small rain aboard one of them will drive you back home. But this is a boat that lets you have fun aboard even in a downpour.

The cabin is light, large, well equipped. There's room to relax in snug comfort, regardless of rain or shine. And the aft curtains are so designed that they give full headroom in the entire rear cockpit. You can be aboard on a rainy day and have the use of the cabin and the whole cockpit area. True, you may not wish to cruise many miles from the dock under such conditions, but this handy combination of well-designed features can give you many extra boating days every season.

In action, the Cruise Liner II proved every bit as handy as she'd looked on the boat-show floor: A well-designed, roomy, ready-to-go family boat. Big enough for all the kids and their friends. Fast enough to delight the heart of a teen-age son. Full of convenience and safety features to win the stamp of approval of the lady of the house. Big and brawny enough for Father. And economical enough in both first cost and upkeep to stay inside the budget. ■ ■

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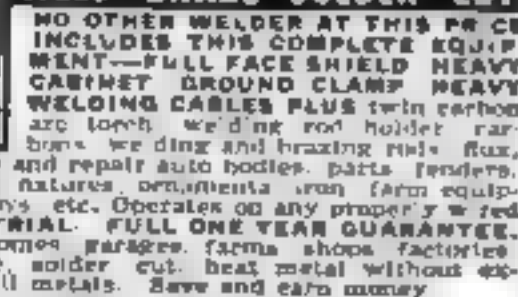
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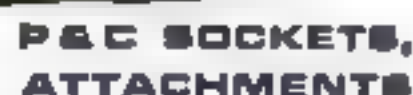
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small molecules out of big ones. In the case of DNA, the pieces—six kinds of sub-molecular units—had been identified. Now it was necessary to figure out how the jigsaw puzzle fitted together.

Another way is to use X rays, but in a special manner. A technique called X-ray diffraction lets physicists take a peculiar kind of look inside certain kinds of molecules—those that form crystals.

DNA extracted from cells and purified is a jelly-like material. Not much resemblance to a crystal, you might think. But when it's pulled like taffy and dried under the right tension, it forms fibers that do have a complicated crystalline structure.

One of the Nobel Prize winners, Dr. Wilkins, is a physicist who worked in this country on the Manhattan Project. After World War II, back in England, he got interested in biological problems and became a biophysicist. During the early 1950s he perfected a method of making X-ray diffraction photos of DNA fibers.

Such photos are taken by shooting a very narrow beam of X rays through the sample. Some of the X rays are bent by interaction with atoms. The emerging X-ray waves interfere with each other to form a pattern that registers on the film.

X-ray diffraction photos do not show the outlines of the molecules they represent. They are in "reciprocal space"—small distances on a photograph stand for large spaces in the molecule, and vice versa. The pictures must be interpreted by mathematical analysis; and the more complex the molecule, the more difficult that is.

Drs. Crick and Watson began to work on methods of interpreting the X-ray diffraction photos of DNA. They met at Cambridge, where Watson had gone to do research a couple of years after getting a Ph. D. from Indiana University.

Working backwards. Crick had worked out a theory for predicting what X-ray pictures of various molecular models would look like. That is, the pictures were so hard to interpret they had to work backwards: devise a model, then determine mathematically what its X-ray diffraction equivalent should be. Then the prediction was compared with actual distances and angles on the X-ray photos.

The two experimenters shared with Wilkins the idea that a twisted, helical molec-

ular structure might fit the X-ray data (it had been discovered that such twists exist in other molecules produced by the cell). They built a model of rods, clamps, and sheet-metal cutouts (representing the various known pieces of the jigsaw puzzle), and evaluated it mathematically.

This first model didn't prove out, and they temporarily dropped the problem, going on to other research. Some months later, in February, 1953, they learned of a structure proposed for DNA by Linus Pauling, Caltech's Nobel-Prize-winning chemist. From their previous work, they knew that Pauling had to be wrong. This stimulated them to try another model, incorporating new information about the exact shapes of some of the subunits of DNA.

A month later they had a model that fitted the X-ray data closely. From it, they worked out the profound "Watson-Crick hypothesis," which explains how the DNA molecule does its work in the cell. That hypothesis has been tested through ingenious experiments in numerous laboratories, and is accepted as gospel in the new world of molecular biology.

The key to life. The DNA molecule stands revealed as a double helix shaped roughly like a twisted ladder.

The two legs of the ladder are identical, but the rungs are not, and this is the key to the molecule's ability to store information. The order of the four different subunits that make up the rungs is the code of life.

The way the subunits link across the rungs is the key to DNA's ability to transmit information. Each rung actually consists of two units, but the pairing of the units follows definite rules; the molecule can "unzip," and each half serves as a template for rebuilding the missing half, producing two new molecules identical to the original one.

The Watson-Crick hypothesis has made possible a new view of the "molecular basis of life": In the cell—really a miniature chemical factory—DNA molecules contain the instructions that tell the molecular machinery of the factory what new molecules to build. The product molecules in turn determine the function of the cell—whether it's a blood cell, a nerve cell, a sperm cell, or (if not part of a many-celled organism) perhaps a harmful bacterium.

DNA: It Calls the Signals for Life

In this way, the information stored in DNA molecules specifies an entire community of cells, such as those that add up to a human being—the color of his hair and eyes, his basic aptitudes, his built-in sensitivity or resistance to disease.

Programming a man. An individual DNA molecule is about 10,000 subunits long (that is, there are that many rungs on the ladder), and the list of instructions necessary to specify a human being is about 10 billion DNA units long. If the DNA molecules containing that message were placed end to end, they would make a strand 10 feet long, but only one twelve-millionth of an inch thick. Actually the strands are bundled in the microscopic bodies called chromosomes, in the nucleus of each cell, which hold the machinery of heredity.

The specifications must be passed on from generation to generation. This takes place during the cell division, when the chromosomes divide. Preparatory to cell division, the DNA molecules in the chromosomes have unzipped and have been copied by the machinery of the cell.

Work in the cell, controlled by DNA, is important not only to healthy life, but also to disease. Viruses, for example, take over cells and turn them into virus factories by interfering with the normal flow of instructions and substituting new instructions. Hereditary diseases are the result of "errors" that have crept into the coded instructions during copying of DNA molecules. Such changes also transform normal cells into cancer cells, which have "forgotten" their usual roles and "learned" new functions.

Those facts explain why DNA has created such excitement among biologists. If a way can be found to send man-made chemical messages into cells and alter the instructions stored there by DNA molecules, almost anything is possible.

But that isn't likely to come about this year or next. First the code must be deciphered. That's where most of the research on DNA is concentrated today.

Another unsolved problem, perhaps even more mysterious, is how cells "decide" to use particular instructions stored in their DNA archives. Discoveries on this frontier will explain how cells respond to outside stimuli—and how a single fertilized cell can multiply selectively to produce the many different kinds of specialized cells that make up a human being. ■ ■



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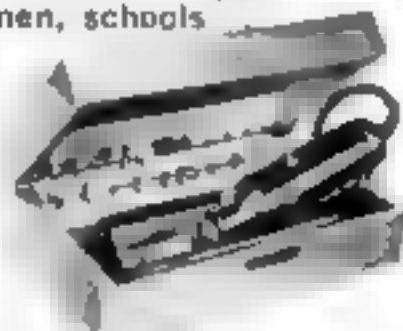
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Popular Science Tests the Hot Compacts

[Continued from page 57]

At higher speeds, approaching the breakaway point, the car becomes an over-steerer—the tail wants to lose traction and slide. The heavy-duty suspension moves the breakaway point up to where it won't be encountered under normal driving conditions. When the rear wheels do break away, the car is easier to straighten out than with the standard suspension.

Surprisingly, the ride is not affected greatly by the stiffer springing. It remains comfortable over all types of road surfaces.

As on most rear-engine cars, the steering is easy. But it could be faster. The four-speed transmission has a light, positive throw. The synchronizers, however, can be beaten during a fast shift.

Parking is a snap. The steering, visibility, short overall length, and lack of excessive body overhang all contribute to maneuverability.

This car cannot be called quiet, but the noise level never becomes unpleasant. There's a sporty purr during acceleration that disappears while cruising. Engine performance is better than adequate. The little six develops good torque at low speed. Approaching passing speeds, the blower suddenly comes on with an unexpected belt. The faster you go, the more power there seems to be. Only when you're close to the century mark does the engine start to poop out.

Falcon Sprint

The Sprint is the spanking-new version of the Falcon that won in its class—based on engine displacement—in Europe's Monte Carlo rally last January. But one significant difference exists between the Monte Carlo Sprint and the Detroit production job: The cars that competed in Europe had four-barrel carburetors; the standard Sprint has only two barrels. Two barrels improve the gas economy, of course, but downgrade the performance. Ford is chary about committing itself to any prospect for four barrels over here.

For the pounds of car that each horsepower had to pull, the Sprint's performance was respectable. It will not move car buffs to ecstasies. The suspension has been hardened a bit to accommodate the added weight of the V-8 engine, and this could be felt in crossing tar strips in concrete pavement and other road irregularities.

Popular Science Tests the Hot Compacts

The rear wheels broke away in a turn only if forced, and the relative lightness of the stern was more obvious in the steering than in cornering. The car did not pitch. At high speeds it was astonishingly stable. The brakes were more than adequate.

For maximum acceleration, the gears on this car should be shifted at 4,600 r.p.m., but the over-run on the busy little engine causes the driver unacquainted with the car to accumulate some 400 revs more before he can manage to change gears. The car had not emerged from second gear when it hit 60 from a standing start.

The transmission (a Borg-Warner, with a design-assist from Ford) is one of the best. It is positive, the throws are reasonably short, the ratios are well-spaced, and it provides no back-talk.

The Sprint's great fault is in its weight distribution. It steers like a truck. While the heavy front end gave it the stability of a locomotive, it made parking a chore. Even under way, at low speeds the steering required a disturbing amount of effort in the turns. This poses the standard dilemma for the design engineers—should they add the weight of power steering to take care of a front end that is already overweight?

As good as it is, the overall performance of the Sprint could have been better—the car had less than 600 miles on the odometer. Engine and drive train were still stiff.

Olds Jetfire

The Jetfire's suspension is medium-firmer than that built into the rest of Oldsmobile's lines. Body lean on turns is moderate but does not seriously impair the roadholding. Cornering hides no unexpected tricks.

This car understeers throughout. It's still understeering when the limit of adhesion has been reached. The front end breaks away gently. The rear won't slide out unless you want it to very badly.

The steering on the test car did not feel as slow as the figures in the table indicate, but it still could stand some speeding-up without increasing the manual effort too much for comfort. The parking was easy, the visibility good.

The Borg-Warner gearbox was a beauty. Close ratios allowed fast, easy shifts with a minimum loss of r.p.m. The synchronizers were hard to beat. The well-placed

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Popular Science Tests the Hot Compacts

stick had short, easy, and precise throws.

The engine was quiet except under hard acceleration. Then it developed a purr that was pure Mendelssohn. Our 0-60 runs were started by revving the engine to about 2,000 r.p.m. and easing out the clutch, keeping the wheels just on the verge of spinning. With the torque that the Jetfire develops, wheel spin is an ever-present problem. Upshifts were made at about 5,300 r.p.m.

The brakes were only adequate (reflecting the minimal swept area for the curb weight). Stops were straight and even, but the car should have snubbed down faster.

Two bleats are in order: The horizontal speedometer was hard to read, and the Mickey Mouse power gauge would have been far more useful if it had carried vacuum-gauge graduations.

One point should be stressed about the turbocharger—its boost is not confined to higher speeds, as in the Corvair. It provides a healthy boost at all speeds. In fact, a Jetfire topped its class at the 1963 Pure Oil tests, doing 0-60 in 8.8 seconds.

Pontiac Tempest

POPULAR SCIENCE's Le Mans model offered brute acceleration. In pure seat, this V-8-powered car is the fastest of the five compacts, as its pounds-per-horsepower would indicate. At 70, there's still enough reserve power to push you back hard in your seat.

Except for its lower axle ratio, the test car was essentially the same as the one that ran away from seven Corvettes (including six '63 StingRays) and a brace of Ferraris in the 250-mile American Challenge Cup race at Daytona last February.

The brakes felt adequate, but it is only fair to say that the Tempest's big brothers at Pontiac have better ones. A redesigned suspension is much improved over '62. Because of the independently hinged rear wheels, the ride proved to be unusually comfortable. This does contribute, however, to a marked oversteer. The terrific torque adds to it. Too much or too little gas on a fast turn could make her spin.

Even so, the point of breakaway is higher and less sudden than last year. This, no doubt, is helped by the considerably stiffer spring rates all around that were made necessary by the hefty engine.

The test car's transmission was not synchronized in first gear. The synchronizing rings could be beaten, and the throws were quite long. The steering was easy, reflecting the number of turns lock-to-lock, but for an impatient driver, too slow.

The instrumentation was good—what there was of it—and the round speedometer easy to read. The tachometer would have been more fun if it had been moved to the left where it could be seen better.

Super Lark

Stabilizing bars gave the Lark the decorum of a church deacon in hard turns. The rear end broke away only under considerable pressure. The car was highly stable at 100 miles an hour, with practically no tendency to pitch. The suspension was firm but the ride, nonetheless, smooth.

The brakes (disks in front) snugged the car down promptly and as straight as an arrow from 80 miles an hour with hands off the wheel. The gearbox (again from Borg-Warner) had the customary B-W smoothness and agility. The synchronizing ring in second gear on this particular car could have stood some attention—it tended to balk on downshifting from third. Parking, with the overall shortness of the vehicle, was a pleasure.

With an engine peaking at 5,000 r.p.m., an acceleration of 0-60 never reached third gear. Upshifting to third at 60 m.p.h. was like a kick in the pants. Traction bars, shrewdly added to the rear axle to accommodate the torque of the blown engine, effectively prevented axle windup and any hesitancy when the accelerator went down from a standing start.

The instrumentation properly included a vacuum gauge for the power output, even though it was only a temporary installation. The remainder of the panel, we suspect, will undergo a styling renovation for '64. For a car of this performance—take a glance at the top speed in the chart—the customer will demand more glamour.

For a front end weighted with a V-8 and supercharger, the steering was surprisingly easy—due, no doubt, to a steering ratio that is high for a compact. The only really vexing design component was the pedals. Offset to the left, they took getting used to. It required rapt attention to hit the clutch with the left foot and the brake with the right. ■ ■

The answers to the questions were in the textbooks. The resistance of copper is quite low, but it does have some. And it increases with temperature. If a circuit is entirely copper wire of uniform size, the whole length of the wire will get uniformly hot. But if part of the circuit is much smaller in cross section, that part will have more resistance and will start to heat faster. As it heats, the resistance goes up still more and it heats still faster. The heat, then, tends to concentrate at that point. These facts gave Weller his clue.

Limiting the current flow was simply a matter of applying Ohm's Law: If you are committed to a circuit of very low resistance, then you have to use a very low voltage. A step-down transformer, lowering ordinary 110-volt power to a much lower value than had been considered before, was the answer.

Weller designed a pistol-shaped soldering gun using these ideas and got his patent on it in 1941. He tried to peddle it to the major manufacturers, but they all rejected it as impractical. In desperation, he built 274 guns by hand in his basement workshop and sold them to individual radio service shops. The men on the job were so enthusiastic about the new instant-heat soldering tool that he started to manufacture them on a modest scale in 1946—the beginning of the Weller Electric Corp.

The man behind the gun had only a public-school education. Energetic, untalkative, single-minded when he's grappling with a problem, Weller prefers to run his business from behind a lathe rather than an executive's desk. He thinks with his hands as well as with his brain. One of his pet ideas is that anything you want to know, you can find in a book somewhere. He has proved it repeatedly by making himself an expert on such widely diverse subjects as tax law, production-machinery design, and reciprocating magnetic motors.

Today, the Weller Electric Corp. of Easton, Pa., has two factories in Puerto Rico, too. Weller has invented and makes a number of other tools—a power sander, a saber saw, and the Magnastat soldering iron with built-in temperature control for production-line work.

And it all started because a radio repairman got impatient waiting for his soldering iron to get hot. ■ ■



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Tent Trailers—Buy or Rent One

[Continued from page 120]



One of a pair by Heilite, the tent folds like an accordion. One model rides single wheel.

the usual camping-trip clutter. The trailers are accepted at most public camp grounds.

The old-timers in the field offer both off-the-ground and on-the-ground types, with a full line of extras (spare tire and wheel, canopies, enclosed porches). Sears boasts that Sir Edmund Hillary tested their trailer in a 10,000-mile cross-U.S. trip. Montgomery Ward has by far the largest enclosure (7' by 22'—by permanently attaching the sun porch). A couple of makers also offer pop-up tent units for use on a pick-up truck.

Manufacturers of tent trailers include Vesely Mfg. Co. (Apache), Box 151, Lapeer, Mich.; Ward Mfg., Inc., (Nimrod), 2530 Spring Grove Ave., Cincinnati 14; Heilite Trailers, Inc., Lodi, Calif.; Right Products, 213 Dunn St., Cincinnati 15; Craig Mfg. Co. (Trade Winds), Manawa, Wis.; Bethany Fellowship, 6820 Auto Club Rd., Minneapolis 20, Trimline (Gator), 11820 W. Ripley Ave., Milwaukee; Norjack, 600 S. 108 St., Milwaukee.



Shape is a teepee, and that's its name. Bethany Fellowship, Inc., Minneapolis, makes it.

Now—Inventing Is Easier Than Ever!

[Continued from page 74]

crude. Why not cement them on? The system he devised is beautifully simple. The wiring units are coated with a cement that stays sticky when covered with a plastic. To install them, you just peel off the plastic covering and push the unit into place. There it stays, fastened for good. Patentable? It was, as patent No. 3,029,303 attests.

Plastics are a happy medium for many independent inventors. Joseph Kitson of Connecticut was impressed with the marvels of polystyrene bubble-type plastic and with it invented a new form of building material. His patented discovery consists of a method of filling the bubbles with a fluid grout after panels of the plastic are in place in the building. He's hit on a scheme that gives structural strength to a light, easily handled material.

Sleeper. A Minnesota physician, Robert Horton, has the gratitude of many parents now getting a good night's sleep. With the help of plastics, miniature batteries, and transistors, he invented a device that puts squalling babies to sleep in a couple of minutes.

Noticing that babies are soothed by a humming noise, Dr. Horton tracked down the sound they like best—B flat. A few years ago he'd have been stumped by just how to make a gadget small enough and safe enough to utilize this discovery. It was no problem today. A buzzer that gives the right vibration, a tiny battery, a transistor to cut power demands and give it a 2,500-hour life, and a neat, smooth, plastic housing suitable for placing in a baby's crib were the ingredients that gave the doctor his now widely sold Slumbertone.

The miniature battery that powers Horton's baby-comforting buzzer is one of the hottest ready-made invention components ever to emerge from the big labs. Independent inventors have used them to power everything from pencil sharpeners to swizzle sticks. At least 100 battery-powered toys—games, tanks, planes, submarines, boats, and animals—are the brain children of free lancers.

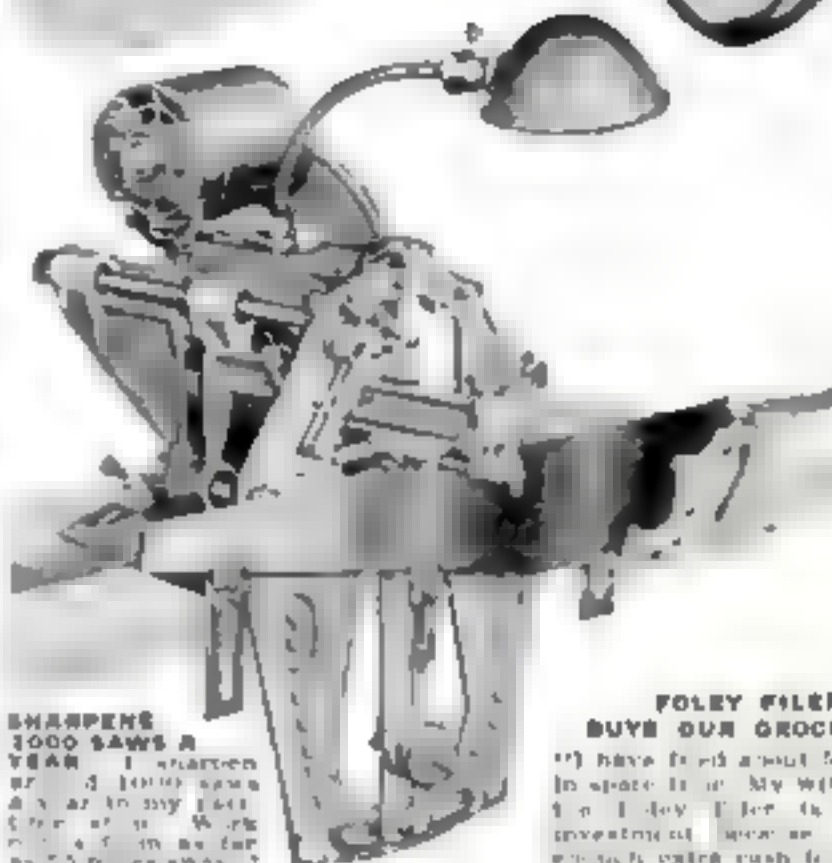
Combining the parts. An invention that's typical of the way inventors profitably team up peanut batteries and small electric motors is that of Ingle McAda of Wichita Falls, Tex. He took an ordinary duck decoy, installed a propeller shaft, a small electric motor, and a battery. His tethered

CONTINUED

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—Joe H. Walker.

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investment. I edit
which costs cash to buy
groceries." — H. J. Kreuser.

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The new model 200 Foley Saw Filer (shown above) is the first and only machine that automatically sharpens combination (rip and cross cut) circular saws—also all hand saws, band saws and crosscut circular saws. The adjustments are simple—there is no eyestrain—and you can start right away to turn out perfect cutting saws. Exclusive jointing action evens up irregular teeth—old saws cut like new!

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Now—Inventing Is Easier Than Ever!

duck decoy could thus be moved realistically. His patent is broad enough to cover plastic decoys of his own design, but McAda got a running start by using existing ones.

While new developments offer virgin territory, a lot of successful inventors advise: Don't ignore older materials and devices. Plenty of opportunities await the alert amateur who is aware that big-business researchers can miss some pretty big bets.

Offhand, you'd hardly think there was any new way to exploit the small gasoline engine, yet Harry Leedom, a California engineer, found one. He evolved a unique wheel-power combination in which power from a small motor is delivered directly to a wheel by a belt running in a deep groove in the circumference of the rubber tire. Leedom's powered wheels in various sizes, along with the forks and brackets that adapt them to everything from scooters to cultivators, are now in production.

No patent problem. A question frequently asked by would-be inventors who would like to use ready-made parts is the one about patents. Isn't it harder to get a patent on a device that utilizes components previously patented? The answer is no. An amendment to the patent law, passed in 1952, says, "Whoever invents or discovers any new and useful process, machine, manufacture or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor." Furthermore, the definition of that word "process" is spelled out to include "a new use of a known process."

Another practical question is "Where do you obtain the makings for an invention?" You've dreamed up something that calls for a particular kind of plastic—how do you find a manufacturer of the stuff you need?

The answer's pretty simple. If you don't find it on the shelves of your local hardware store, and you don't see a suitable company listed in the telephone book, you turn to the inventor's friend, *Thomas' Register of American Manufacturers*.

If you live in a town of any size, your local public library is likely to have it. In its 9,030 pages you will find the names of everybody who makes anything. An index will lead you to the right page. You can then contact the manufacturer and get the names of dealers or suppliers, or such product information as you need.

Help from manufacturers. This can be a

wonderful lubricant to easing your invention along its way. Most companies, and all big ones, publish reams of technical literature, full of hints for inventors. For instance, Bakelite's "Technical Release No. 12" gave Charles Powell the information he needed about the company's polymerized vinyl resin to make possible his do-it-yourself sculpture.

The help may go beyond printed literature to discussions with company technical representatives, especially if your invention gives promise of providing a sizable market for the company product.

"A technical rep," says Harold Humes, who estimates he talked to a couple of dozen of them in developing his paper house, "can be a gold mine of information for the inventor."

Just how much company information can help an inventor is demonstrated by the experience of Michael Meyerberg, a New York theatrical producer who thought American women deserved decent light to put on their make-up. Even in the theater, Meyerberg hadn't seen a properly lighted make-up mirror. Fluorescent lights of low wattage around the mirrors didn't provide enough light or distribute it right. Incandescent lamps of sufficient wattage were too hot; low-wattage incandescents didn't give enough light.

Meyerberg got in touch with GE. Sure, company engineers told him, they had just the thing—a 15-watt lamp, with a special frosting inside, that gave a strong, diffused light but didn't get hot.

"I had my invention made the minute I found out about that lamp," he says.

He rigged up a compact, three-part mirror suitable for theater or home use, mounting five of the bulbs on each post and four above the center mirror. That was all there was to it—but it won him a patent.

More developments on the way. One thing is sure. The basement inventor isn't going to run out of opportunity. Thermo-electric plates, to deliver power without batteries or outside source; new plastics like Delrin, which is tough enough to secure automobile parts, pinhead-size microphones that can make all kinds of mechanisms respond to the spoken command—the list of new developments that are almost wholly unexploited is growing daily.

Among them will you find the makings for your million-dollar invention? ■ ■

pole-vault authority, took movies of champion vaulters and analyzed their techniques frame by frame. He surprised the athletes by pointing out such major faults as waving of the pole during approach, failing to slide the hands together at takeoff, varying stride, even dangling legs. When the faults were corrected, heights went upwards.

Form perfection in pole vaulting is the principal reason for consistently climbing marks. But the use of fiber-glass poles also helps—which introduces the last major reason for those breaking records:

Better equipment

Just how important is the new pole? Dr. Ganslen thinks it highly overrated: "With the fiber-glass pole, the vaulter does less work at the start, but more at the end. . . . The pole has no energy except what the vaulter gives it. It's still the man on the end that counts," he says.

Veteran Cornelius Warmerdam, one-time 15-year holder of the world outdoor record, concurs. "The only difference is timing; some vaulters get as much bend out of steel poles."

But most disagree. Said vaulter John Cramer last summer: "I guess I'm the last man in the U.S. to use a metal pole. Looks like I'll be forced into changing. With fiber-glass poles, you can grasp a foot higher and hold on longer, and the pole itself acts somewhat like a catapult."

Kenneth Baldwin, sales manager for equipment-making Harry Gill Co. (which sells very few fiber-glass poles) puts it this way: "The nature of fiber-glass—its slow, unwinding action, yet its strength—has done the whole thing. Take a fellow like C. K. Yang [UCLA senior from Formosa], who goes 14 feet, 7 inches with an aluminum pole, then in his next competition makes 16 feet 3½ inches with fiber-glass. That was unheard of with metal poles. You had to work your way to heaven inch by inch; now you get there by the foot."

Another controversial piece of equipment is the javelin. Argument centers primarily around the "Dick Held" implement, developed by Dick and his javelin-throwing brother, Bud. The brothers started fooling around with javelin design in 1953, figured that by changing the shape, moving the center of gravity, and using stiffer material, two adverse factors could be eliminated:

1) quick dip of the point, causing the spear to drop too soon, and 2) in-flight wobble, resulting in increased drag.

Evidently they were right. That same year, Bud walked off with the world record of 263 feet, 10 inches—up more than 5 feet.

Crashing javelin records worried officials, old spear throwers, and investigators like Dr. Ganslen. He subjected Held's and conventional javelins to wind-tunnel tests, concluded that the increased surface area on Held's implements give them odd airfoil qualities. He raised the question as to "whether one wishes to throw javelins or gliders."

Replies Dick Held: "I think Dr. Ganslen's remark is off-base. . . . Why should the javelin man be content with throwing an implement which doesn't allow him to get the best results?"

The Amateur Athletic Union, the International Amateur Athletic Federation, and the Olympic Rules Committee seem to have agreed with Ganslen: Rules for javelin specifications were tightened. But records *continue* to be broken with a modified version of the Held spear.

Still more improvements

Less changed is another track-and-field missile, the discus, dimensions of which are painstakingly set down. Last June in Los Angeles, muscular Al Oerter, latest and best in a line of discus throwers that stretches back to ancient Greece, swung his right arm back, coiled and spun, and with a grunting explosion of breath whirled the maple-and-steel discus at 55 m.p.h. out past the 200-foot mark, breaking another "insurmountable" barrier.

What's his secret? The discus Oerter threw had a small innovation: The rim, ordinarily slick, was sand-blasted to provide a better grip. But the important thing in equipment, he told me, wasn't the discus at all. It was the new concrete surface he whirled upon.

"With concrete we don't have to wear spikes," he said. "On dirt you need them so you don't slip. But how do you spin on spikes?" On concrete, Oerter wears smooth-soled tennis shoes. (Great, bull-like hammer throwers, by the way, are now donning dainty ballet slippers, the better to spin with.)

Runners today are also finding some-

Science or Supermen?

thing new underfoot. Cinder tracks once were the thing, but they become uneven, mushy, tiring to run on—especially when wet. Resilient modern "all-weather" tracks (and field-event runways) are being topped with waterproof compositions of asphalt, cork, and rubber grounds. The University of Wisconsin resurfaced its track with the new material in 1959. In the first two Big Ten meets held there, 11 out of 13 records were broken.

Even the Russians are questioning their old cinder tracks. On the way to Philadelphia for a 1959 U.S.-U.S.S.R. meet, Russian trackmen insisted they'd not run on Franklin Field's newly installed resilient, all-weather track. A quick tryout changed their minds. Last October, Khrushchev Stadium in Kiev got a new track surface—startlingly similar to Franklin Field's.

Along with men, horses soon will be getting a break—and breaking more records. No more flying mud if a new Minnesota Mines product becomes universal. It's a less-than-inch-thick layer of synthetic resin topped with granules, laid over blacktop and stone. And last year, for the first time in the Indianapolis Speedway's 46-year-old history, cars sped over an all-asphalt track, covering the old rough and dangerous brick. Result: the fastest time ever. Rodger Ward averaged 140.292 m.p.h.

Even in golf, new equipment is lowering old scores. Main thing here is uniformity—clubs that really do match. According to Jack McGrath of Hillerich and Bradsby Co., club maker, the greatest single golfing advance came with the introduction of the steel shaft. Shafts used to be hickory, a fine material. But no two pieces of wood behave exactly alike. Steel pieces do. Same thing with the grip and the head. Now they're uniform and give predictably regular results. A top golfer today knows that if he hits the ball every time at the same angle with the same swing, it's flight will be the same every time.

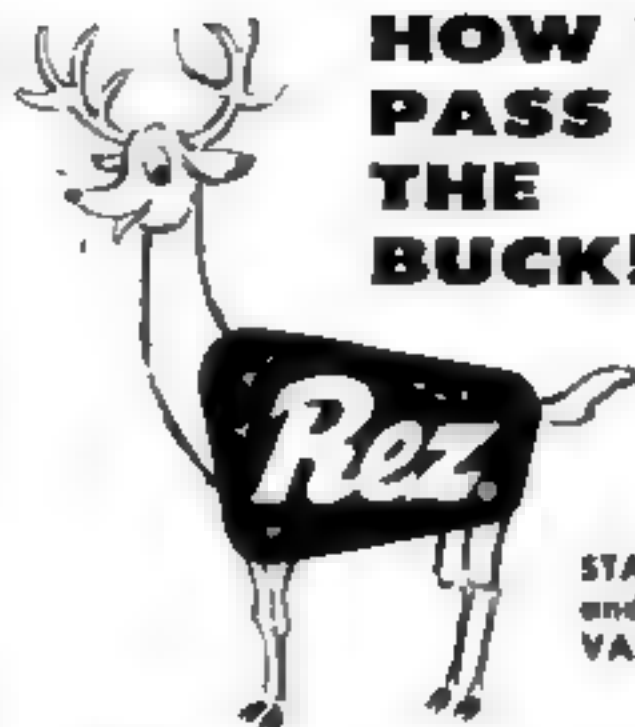
Even the balls are consistent, with dimples aerodynamically designed and uniform. (A smooth golf ball, by the way, would travel a far shorter distance than the dimpled ball; the 5,000 r.p.m. backspin of a dimpled ball creates extra lift.) Take two balls at random today; you can rely on their going the same distance.

In football, the big thing is lighter equipment. Weight has dropped from around 21

CONTINUED

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Science or Supermen?

pounds in the Thirties to about 12 pounds today. Use of the two-inch tee also has boosted scores; in the old days the ball was booted from a little mound of dirt. Another thing: No modern-day passer could get his favorite grip on those old fat, round balls.

All balls used in sport (except baseballs, insist the manufacturers) have been improved. Tennis balls are more uniform (as are the court surfaces); footballs are chemically coated to give a more "natural" feel and better grip; soccer balls and volley balls no longer bounce at a tangent. Basketballs are nearly two inches smaller than they were before World War II—and thus sneak through rims more often.

But if baseballs haven't changed, why is it that home runs are commonplace? (In 1909 Ty Cobb led the American League with nine homers; in 1961 Roger Maris hit 61.) According to some experts, it's the shape of the bat. "There's a vast difference between today's bats and those used, for example, by Ty Cobb," says Hal Schumacher, major-league pitcher from 1931 to 1946. Bats of the old era, he says, "tapered very gradually from the tip of the barrel end into a very thick handle."

Adds bat man Edwin L. Parker, president of A. G. Spalding: "Taller, heavier, stronger, faster baseball players using shorter and lighter bats are waiting longer for the ball and then are bringing those bats around very much faster."

And the gimmicks

Athletes today use many specialized techniques for improving performance:

- Swimmers remove all hair from their bodies to slice time by a few microseconds.
- Hockey players whiff pure oxygen for that extra spurt near the end of the game.
- Divers used to snug their knees under their chins; now they stick their heads between their knees, spin faster, get in more turns.
- Sharpshooters file down their handgun hammers; the weapons don't jar so much when they pull the trigger.

A hint: If you want to beat your own field record, compete near the equator—gravity is slightly less there. A Swedish shot putter at the equator should be able to add two inches to his home score, a broad jumper about an inch, and a javelin thrower more than a foot.

How to Fit Out an Econoline as a Camper

[Continued from page 127]

For additional cooking, a Harper oil stove sits on the cupboard next to the rear seat. It's handy for coffee-perking, says Hyman, and will also put out enough heat to keep the whole camper warm.

A marine-type pump faucet is mounted next to the sink, with its hose leading down to a water tank at the base of the kitchen unit. The sink drain is connected to another hose that runs to a waste container next to the water tank. An ice chest, stored under the sink, slides out on a clever drop-down shelf for easy access. There's practically no meal you can't cook with a setup like this.

Clothes and canned goods are stored in a closet unit that slips in behind the driver's seat as snugly as if it were built in. To avoid interfering with the battery box, which sits behind the driver's seat in the Econoline, the front portion of the closet is cantilevered out and has no leg.

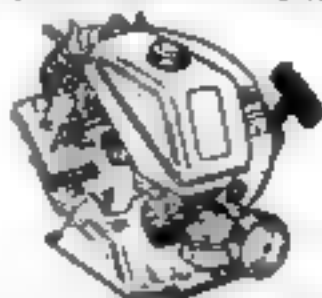
Instead of carrying the closet all the way to the ceiling, Hyman simply extended the clothes rod on brackets. This gives enough height to hang suits and dresses full length without completely blocking the driver's rear view. The open top can be covered with a plastic bag or clear-plastic food crisper, says Hyman, if you want to keep dust off good clothes. The front bulkhead on the closet extends slightly beyond the closet itself on the left side and is curved to fit snugly against the wall of the bus.

A **three-way table** is another ingenious touch devised by Hyman. Made of two hinged sections, it can be fully extended to provide a large table area for the whole family at mealtimes. For playing games, writing letters, or helping the cook, the outer section can be folded down to make a small table that doesn't get in the way of other activities. For sleeping, both sections fold neatly out of the way against the wall.

A tricky mount hinges the table to the wall. It consists of two long T hinges bent at the ends to form hooks. These hook into a seam in the Econoline's wall paneling just below the windows. Another bend in the hinges allows for the thickness of the outer table section, which folds inside the inner section when both halves are collapsed. The drawers in the front bench are set 2" in from the wall end to allow them to open with the table folded. ■ ■

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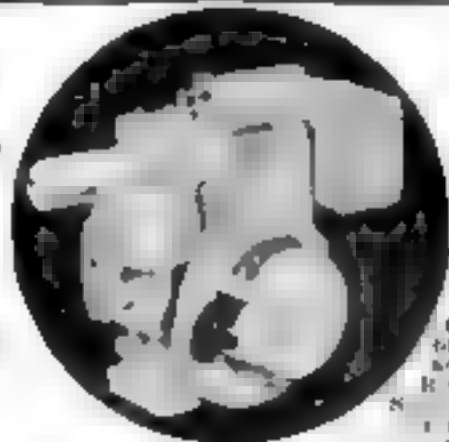
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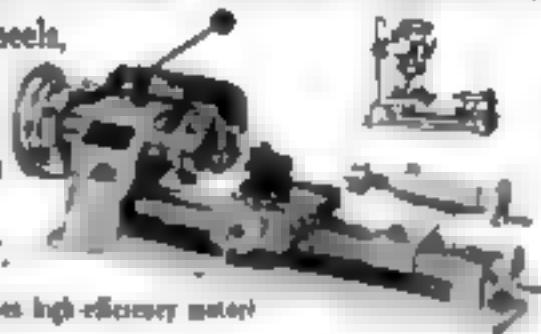
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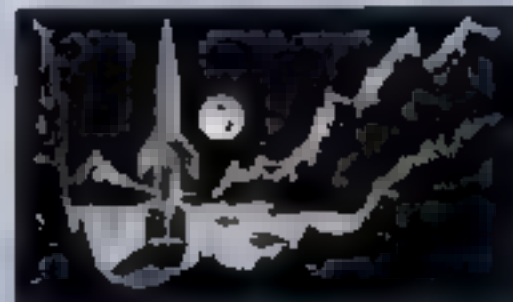
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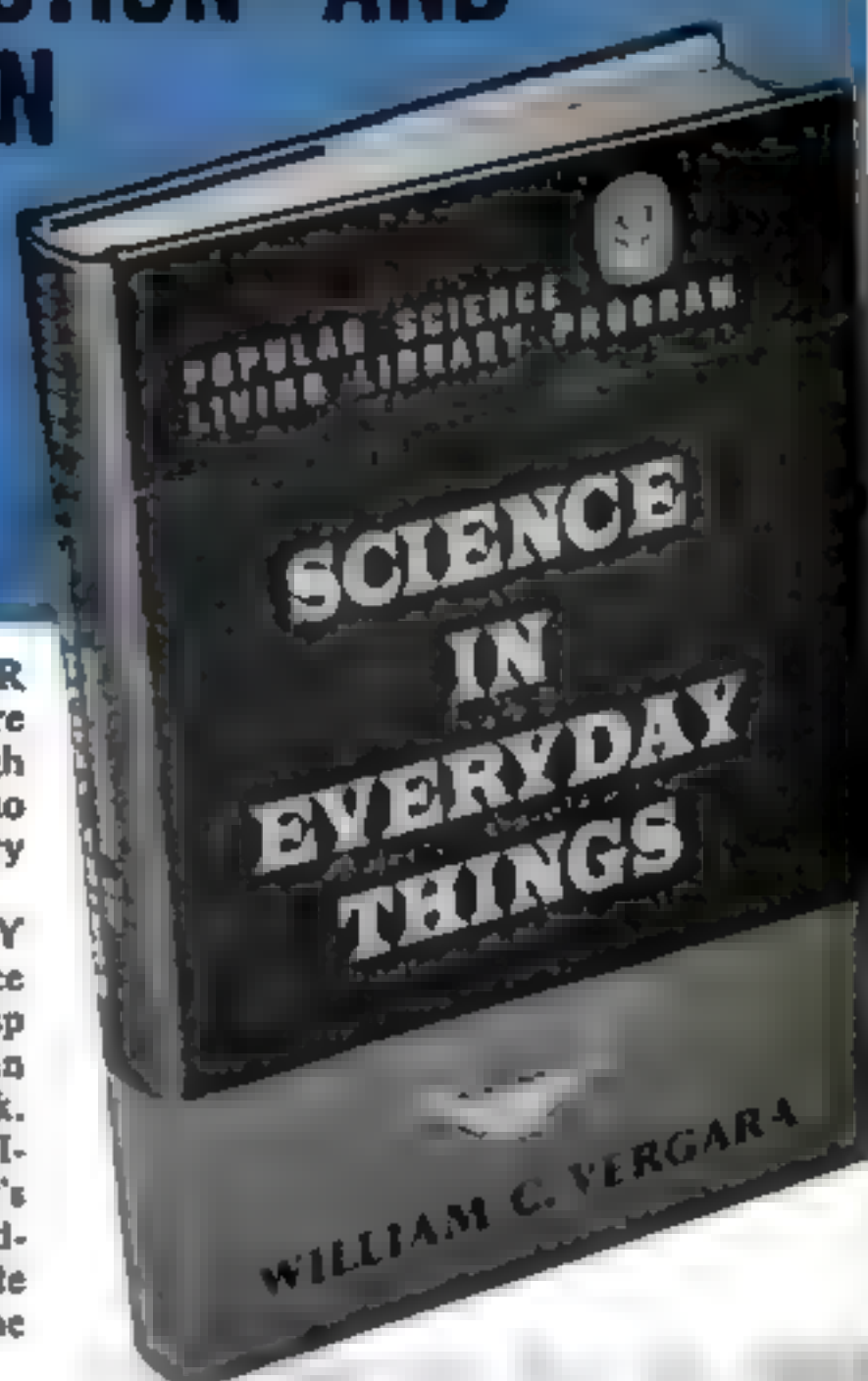


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Life Beneath the Sea

Can Detroit Move In on Indy?

[Continued from page 78]

Half of that confidence comes from the drivers he's signed. Foremost among them is world champion racing driver Graham Hill.

Let's take our own look at the hardy perennial champions—the Meyer-Drake-powered Indy roadsters. The severest critics of the Offy cars say they're everything a modern race car shouldn't be: overweight and unimpressively suspended; incapable of steering maneuvers more sophisticated than warping around left turns in splaying arcs; propelled by four-lungers dreamed up before Roosevelt ran against Hoover.

Yet the basic simplicity of the big bombers has always paid off in a race that's first and foremost an endurance contest. Gulping down a gallon of fuel every minute and a half, the Meyer-Drakes have what it takes to shrug off the punishment: relatively few parts, and years of conditioning. Add to that the engine's tremendous torque. The fewer the cylinders for a given displacement, the greater the twisting force. This is why the four-banger squeezes an amazing 420 horsepower from 235 inches.

The roadster chassis is something else. Considered an engineering triumph when it was introduced to the Speedway in '48, it's now admittedly obsolete.

What irritates the designers-mechanics who have nursed the chassis to the limit most is the visits Motor City engineers pay the track each year, to mosey in the pits and focus binoculars on the race. They'd learn a lot more, say the frustrated wrench artists, if they'd join us in an active program—and spend some money.

It's no secret, either, that the sponsors of this year's brand-name-engined race cars are on their own.

Body blow to name brands. But there's a growing belief the picture may change. Passenger-car merchandising didn't benefit from Indy participation 30 years ago. That was when Harry Miller's huge Specials took the show away from the last of the modified Buicks, Chryslers, Fords, Hudsons, Hupmobiles, Oaklands, Packards, Reos, and Studebakers. Coupled with that body blow, the Great Depression ended the customer-appeal of fuel-greedy chariots.

But now the accent is again on floor sticks and unbridled horses. Detroit has warmed to the stock-car races. There could be a reconciliation with the Speedway if the new contenders show up well. ■ ■

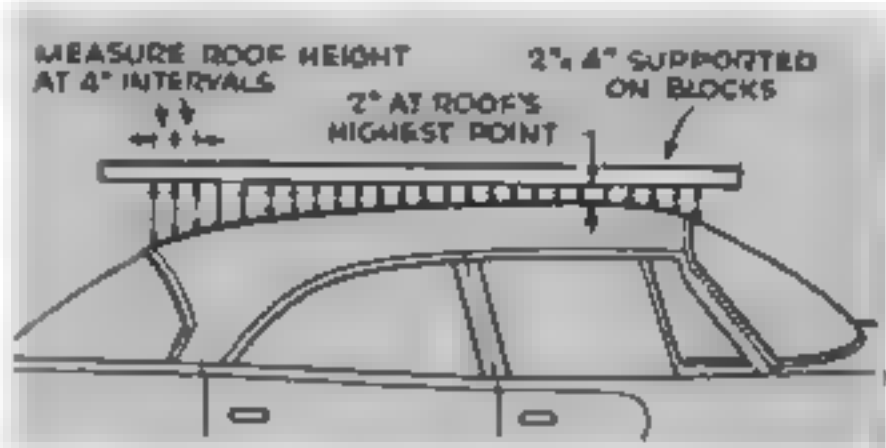
A Car-Top Sleeper You Can Build

[Continued from page 138]

The top half of the sleeper is a lightweight shell made of two curved side pieces with cross strips in between. The top can be covered with any material thin enough to take the 10"-radius curve at the front. Lindblad used $\frac{1}{4}$ " wood veneer covered with fiber-glass cloth for an extra-slick effect, but this isn't a must. Thin hardboard, sheet metal, or canvas, could be used.

In its raised position, the top is held by four telescoping poles, cleverly arranged to provide a rigid support—although the poles themselves are loosely pivoted. The secret: The poles all slant in toward each other. In order to swing outward, the top would have to be raised up and over the high point of the poles' arcs. Since the canvas enclosure is stretched taut between the top and bottom, this can't happen, and

How to find the shape of your car's roof



Level a two-by-four across blocks and measure down to roof at 4" intervals. Lay out a profile and cut sleeper's supporting ribs to this shape. Repeat the process for each rib location.

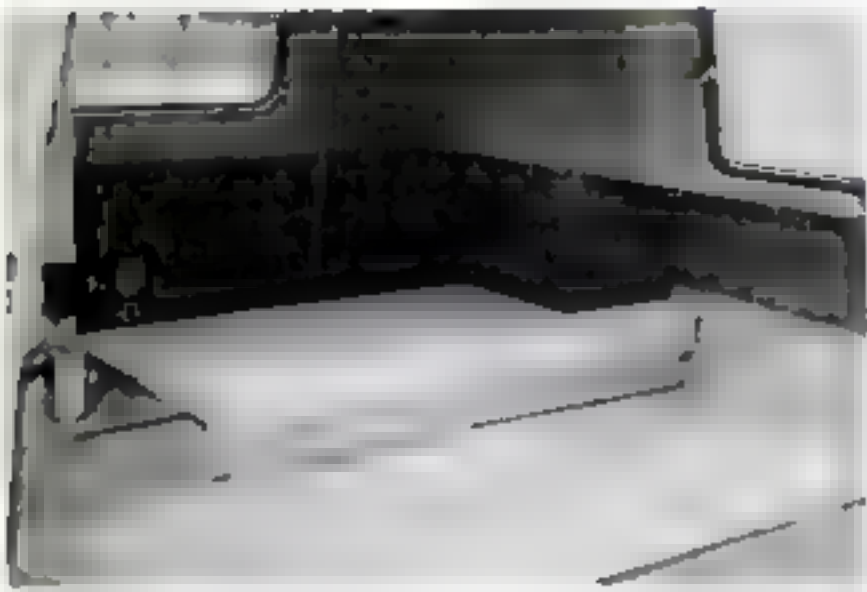
the entire assembly becomes a rigid unit. Hooks for the poles are bent bolts with their heads cut off.

The canvas enclosure is stapled inside the top, except for one short section, which is held by snap fasteners. This section can be opened to make an entrance. The lower edge is held entirely by snap fasteners so the top can be easily removed. You'll need eight yards of canvas 39" wide. Separate strips, 8" wide, are sewn near the bottom to overhang the rails and keep out rain.

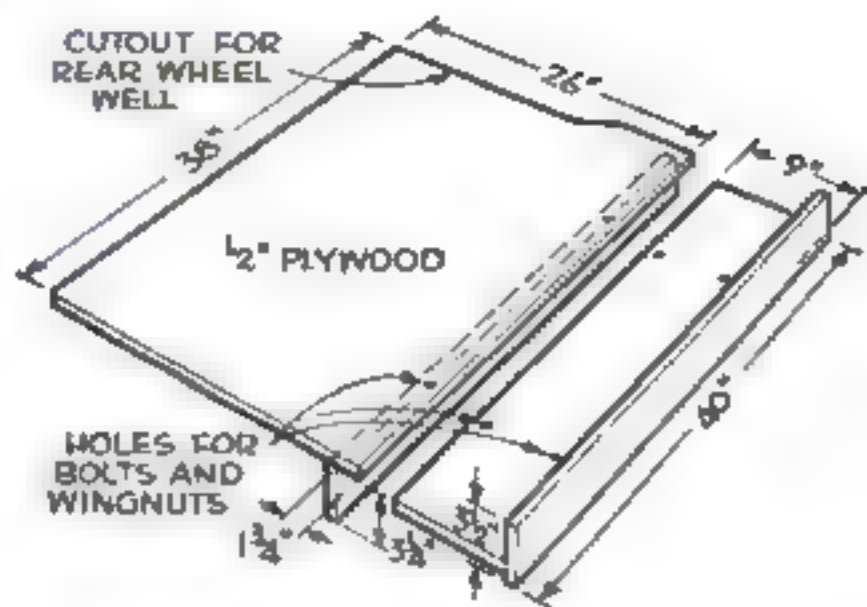
Window openings are cut in the sides and can be covered in bad weather with flaps. When the sleeper is collapsed, the enclosure folds inward and stores itself without having to be detached. Small toggle-type luggage latches hold the top to the base in the closed position. ■ ■

How to Fit Out a Microbus as a Camper

[Continued from page 130]



Double bed rests on removable platform extending out over the seat box. A separate lip is fastened to the underside of the platform with two bolts and wingnuts to hold bed cushions in place (lower photo). In the morning, the platform is slid back, and the lip is removed and bolted to its top (upper photo). Lip now serves as a back rest for the daytime seat cushions.



ready-made tanks can be fitted into the same space, or you can have a tank made at a sheet-metal shop. Two fill hoses are connected to the tank. One leads to a conventional trailer-type filler fitting mounted alongside the kitchen counter. This is used for pouring in water from a pail or pitcher. For faster filling, a second hose is fitted with a garden-hose connection for use when an outside sill cock is available.

The kitchen unit includes shelves for canned goods, racks at one end for small jars and utensils, and a slide-out work table. A Bernz-O-Matic gas-electric refrigerator sits atop the rear seat box. It can be run on gas or on 12-volt DC or 110-volt AC.

The converter that Geraci uses to supply 110-volt current is housed in the seat box under the refrigerator, with slots cut in the sides of the box to vent the converter's heat.

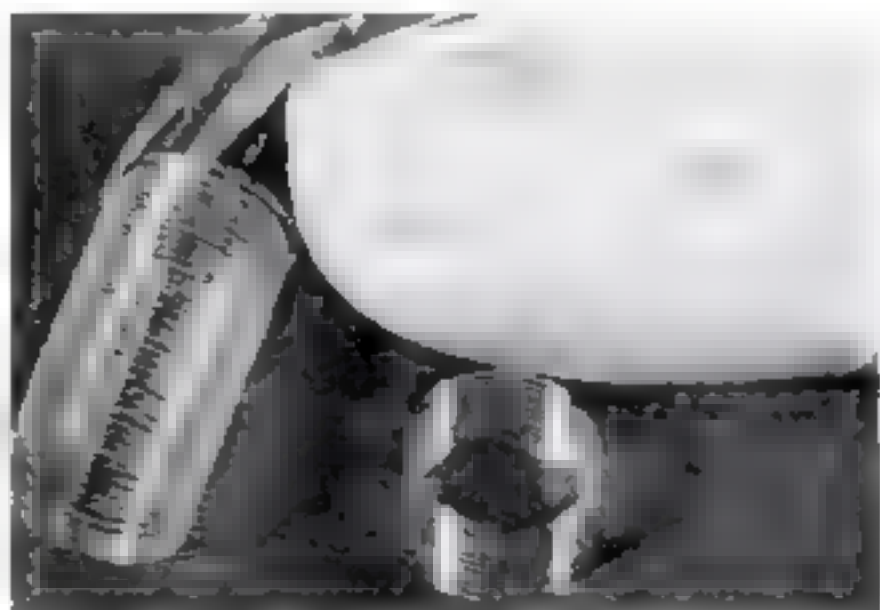
There are no hinges on any of the storage compartments. The lids on the seat boxes simply lift off. They're kept from sliding by cleats on the underside. The doors on the clothes closet are held on by magnetic catches—the kind that are sold for conventional cupboards. But here there are catches on *both* sides of each door. ■ ■

water up from a 25-gallon tank to an outlet hose at the side of the kitchen. It works like a faucet; flipping a switch starts the pump. Shutting off the pump stops the flow.

Geraci used a homemade tank that just fits the space at the back of the kitchen, but this isn't necessary. Any one of several

Tiny springs made from quartz

Coiled from fused quartz half the thickness of a human hair, the little springs (right) are stronger than steel and incredibly accurate. They are said to be capable of measuring the gain in weight of feeding bacteria. They were made by two Lockheed missile-and-space engineers by wrapping the glasslike fiber around a slowly turning mandrel while heating with an acetylene torch. They are expected to aid in measuring gravity, earth shocks, electrostatic charges, electric pulses, and pressures.



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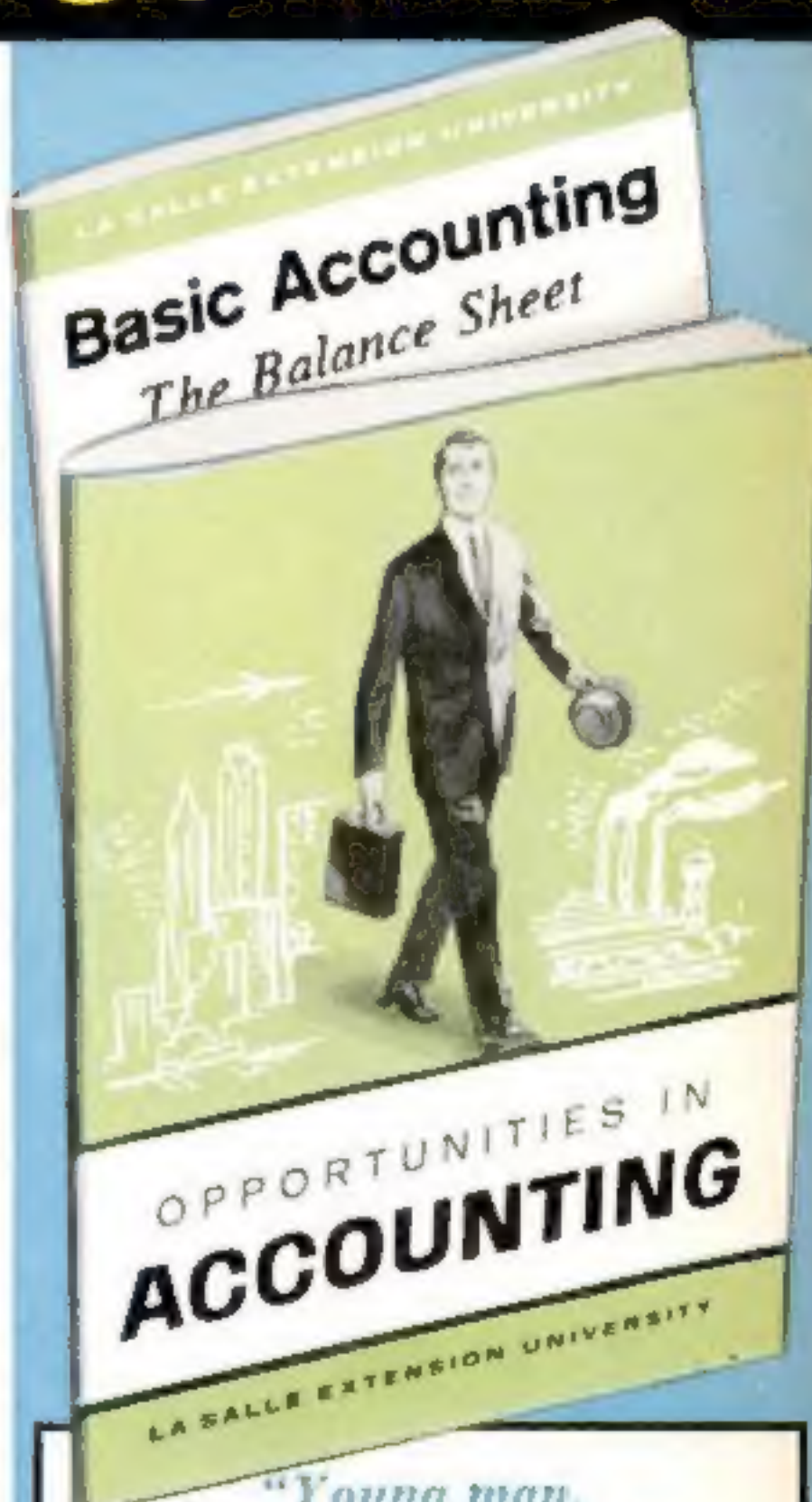
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